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TOTAL AIRFRAME FATIGUE TEST F 104 G  
FINAL REPORT

Schutz

Foreign Technology Division  
Wright-Patterson Air Force Base, Ohio

20 March 1975

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# RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

| Russian   | English                    |
|-----------|----------------------------|
| sin       | sin                        |
| cos       | cos                        |
| tg        | tan                        |
| ctg       | cot                        |
| sec       | sec                        |
| cosec     | csc                        |
| sh        | sinh                       |
| ch        | cosh                       |
| th        | tanh                       |
| cth       | coth                       |
| sch       | sech                       |
| csch      | csch                       |
| arc sin   | $\sin^{-1}$                |
| arc cos   | $\cos^{-1}$                |
| arc tg    | $\tan^{-1}$                |
| arc ctg   | $\cot^{-1}$                |
| arc sec   | $\sec^{-1}$                |
| arc cosec | $\csc^{-1}$                |
| arc sh    | $\sinh^{-1}$               |
| arc ch    | $\cosh^{-1}$               |
| arc th    | $\tanh^{-1}$               |
| arc cth   | $\coth^{-1}$               |
| arc sch   | $\operatorname{sech}^{-1}$ |
| arc csch  | $\operatorname{csch}^{-1}$ |

---

|     |      |
|-----|------|
| rot | curl |
| lg  | log  |

## GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

# U. S. BOARD ON GEOGRAPHIC NAMES transliteration SYSTEM

| Block | Italic     | Transliteration | Block | Italic     | Transliteration |
|-------|------------|-----------------|-------|------------|-----------------|
| А а   | <i>А а</i> | A, a            | Р р   | <i>Р р</i> | R, r            |
| Б б   | <i>Б б</i> | B, b            | С с   | <i>С с</i> | S, s            |
| В в   | <i>В в</i> | V, v            | Т т   | <i>Т т</i> | T, t            |
| Г г   | <i>Г г</i> | G, g            | У у   | <i>У у</i> | U, u            |
| Д д   | <i>Д д</i> | D, d            | Ф ф   | <i>Ф ф</i> | F, f            |
| Е е   | <i>Е е</i> | Ye, ye; E, e*   | Х х   | <i>Х х</i> | Kh, kh          |
| Ж ж   | <i>Ж ж</i> | Zh, zh          | Ц ц   | <i>Ц ц</i> | Ts, ts          |
| З з   | <i>З з</i> | Z, z            | Ч ч   | <i>Ч ч</i> | Ch, ch          |
| И и   | <i>И и</i> | I, i            | Ш ш   | <i>Ш ш</i> | Sh, sh          |
| Й й   | <i>Й й</i> | Y, y            | Щ щ   | <i>Щ щ</i> | Shch, shch      |
| К к   | <i>К к</i> | K, k            | Ъ ъ   | <i>Ъ ъ</i> | "               |
| Л л   | <i>Л л</i> | L, l            | Ы ы   | <i>Ы ы</i> | Y, y            |
| М м   | <i>М м</i> | M, m            | Ь ь   | <i>Ь ь</i> | '               |
| Н н   | <i>Н н</i> | N, n            | Э э   | <i>Э э</i> | E, e            |
| О о   | <i>О о</i> | O, o            | Ю ю   | <i>Ю ю</i> | Yu, yu          |
| П п   | <i>П п</i> | P, p            | Я я   | <i>Я я</i> | Ya, ya          |

\*ye initially, after vowels, and after ъ, ь; e elsewhere.  
 When written as ё in Russian, transliterate as ye or ë.  
 The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

## GREEK ALPHABET

|         |   |   |   |         |   |     |
|---------|---|---|---|---------|---|-----|
| Alpha   | A | α | • | Nu      | N | ν   |
| Beta    | B | β |   | Xi      | Ξ | ξ   |
| Gamma   | Γ | γ |   | Omicron | Ο | ο   |
| Delta   | Δ | δ |   | Pi      | Π | π   |
| Epsilon | Ε | ε | • | Rho     | Ρ | ρ ϑ |
| Zeta    | Z | ζ |   | Sigma   | Σ | σ ς |
| Eta     | H | η |   | Tau     | Τ | τ   |
| Theta   | Θ | θ | ↓ | Upsilon | Υ | υ   |
| Iota    | I | ι |   | Phi     | Φ | φ φ |
| Kappa   | K | κ | κ | Chi     | Χ | χ   |
| Lambda  | Λ | λ |   | Psi     | Ψ | ψ   |
| Mu      | M | μ |   | Omega   | Ω | ω   |

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## TOTAL AIRFRAME FATIGUE TEST F 104 G FINAL REPORT\*

Schütz

ABSTRACT. This final report contains the most important information and data on the experimental configuration, experimental sequence, and the results of the F 104 G total airframe fatigue experiment. Details are contained in 31 additional partial reports. In addition, the tables of Appendix B contain all the damage information which occurred on the structure during the experiments. This report can be used as a means of orientation for the information contained in the partial reports because of the cross references in the text and the tables. This final report also contains an evaluation of the most important results (damage) and contains recommendations for their elimination, as well as modifications already made.

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\*Report No. TF 81/20. IABG (Industrial Facilities Operations Corporation), Ottobrunn. Main Division for Strength of Materials, Construction and Materials. Customer: Federal Ministry for Military Science and Appropriations. Contract No. T/L 115 90 115/94 407; T/L 115 10 073/94 407. IABG Task 142 1024; 142 2135.



## 1. General Specifications

The following deadlines and events characterized the sequence of the F 104 G total airframe fatigue experiment:

- beginning of the fatigue experiment in February, 1969;
- fracture of the right main wing in April, 1971, at 6407 total test hours, corresponding to 5997 TCTP test hours;
- continuation of the experiment with a right replacement wing up to 8687 total test hours, corresponding to 6934 TCTP test hours for the left support member, which was reached in February, 1972;
- change of the left main wing and of one troop wing with 1342 hours of use, corresponding to the retrofit program in the time period between February, 1972, to July, 1972;
- renewed start of the fatigue experiment in September, 1972;
- end of the experiment in July 1973 at 14,869 total test hours, corresponding to 6182 TCTP test hours for the retrofit main wing and 14,459 TCTP test hours for the fuselage structure (14,869 total test hours).

In addition to these major milestones, the test sequence was also interrupted by extensive repair and exchange activity, such as for example, many instances of exchange of the wing-fuselage connection fittings, reinforcement of the rear spars, etc., which took many weeks.

All of the decisions concerning the most important measures and modifications within the overall sequence were made with the permission of the customer, the BMVg T IV 8 (formally), the BWB LG IV 2, as well as the BWB-ML, MBB-UF, and the LBF. The participants were informed by the IABG about all important events and damage in the form of short information bulletins.

The concluding documentation for the F 104 G total airframe fatigue experiments was published in the form of 32 partial reports (see Table A1), which can be grouped as follows:

- 6 partial reports which contain information on the preliminary investigations, such as, for example, the influence of flap deflections, investigations of the introduction of loads, etc.;

- 7 partial reports, which describe the test configuration, the loads, the loading program, the measurement points, etc.;

- 8 partial reports which treat the results of the stress measurements, lifetime estimations, as well as related measures (probe rod experiments, inspection methods), etc.;

- 11 partial reports in which the structural damage experienced during the fatigue experiment is described in detail.

The final report presented here gives the most important details in summary form, and this is shown in the following chapters for each of the individual areas.

## 2. Purpose of the Experiment

A complex method of construction comes about in high performance aircraft such as the F 104 G when high strength materials are used in conjunction with the requirement for a high measure of safety for the supporting structural parts. This places relatively high requirements on the fatigue resistance.

Within the framework of the total airframe fatigue experiment F 104 G, we were able to establish fatigue strength for the required or planned lifetime for the primary structure, that is, the wings and the fuselage, in particular the central part of the fuselage for conditions close to the loads experienced during operation.

The total airframe fatigue experiment F 104 G covered the following points which determined the reliability, the operational safety, and the capacity for operation of the structure:

— determination of the fatigue-critical weak points.

Experience up to the present has shown that computations alone or simplified tests carried out by the manufacturer are not sufficient for finding fatigue-critical points. This is especially true for structures having a complex configuration, for discontinuities and segments within the structure, and for points where forces are introduced and where there are abrupt transitions in the cross section. This experience has been confirmed by the experiment described here, which has now been brought to a conclusion. During the total airframe fatigue experiment, we were able to localize sixteen different structural components or regions on the fuselage which can be considered to be especially critical for fatigue. Sixteen such points were also found on the main wing.

— lifetime of the primary structure.

In order to determine the minimum lifetime and in order to define the beginning of an inspection of main structure components, such as for example, of the wing, we used the experimental results from the total airframe fatigue experiment as a base in conjunction with statistical evaluations.

— crack propagation behavior and residual strength.

In order to specify suitable inspection intervals, it is necessary to ascertain the crack propagation behavior and the residual strength of components with beginning cracks. Within the framework of the total airframe fatigue experiment, we fixed the advancing propagation of the individual cracks at several points, in order to avoid catastrophic failure in true aircraft.

— demonstration of fail-safe properties.

The total airframe fatigue experiment showed that the fuselage structure essentially has the fail-safe properties, i.e., that if one supporting element fails, the strength of the structure does not drop below a certain minimum value before the fatigue crack was found.

The wing assembly and especially the lower shell does not have any fail-safe properties over extensive regions. The experiment showed that, when there is a fatigue surface of 3 — 4% of the supporting cross section, a force fracture occurs which leads to a fatal failure.

— testing of inspection methods.

Since the crack magnitudes considered to be critical differ widely for the individual components, it is necessary to work up inspection methods which are sufficient for all of the requirements. The damage which occurred within the framework of the total airframe fatigue experiment represents a basis for testing the effectiveness of inspection methods.

— lifetime estimation for changing deployment concepts of the troop aircraft.

The strain gauges which were applied to the aircraft in order to carry out the stress analysis for all of the load cases which occurred during the test program could be used to determine the local stress collectives which occurred during the total airframe fatigue experiment. The effect on the lifetime can be investigated by carrying out comparison calculations or by simple additional experiments with sample rods, in conjunction with a comparative damage accumulation calculation, in the case where the operational mission changes.

— logistic measur . .

If g countermeasurement units are installed in the aircraft , as a result of the equivalent damage recorded based on g counters, it is possible to determine the planned replacement point in time for each unit on an individual basis. From this, one obtains important information and data for material flow and replacement part procurement. Here again the material and component-specific results of the total airframe fatigue experiment are used as a basis for these investigations.

— development of methods for increasing the lifetime of endangered components.

In order to increase the lifetime of certain structural components which were found to be critical for fatigue because of the findings of the total airframe fatigue experiments or because of analytical derivations and troop experiment, we tested and performed modifications to the materials technology (exchange of materials), manufacturing technology (for example, Coinen, spherical steels) and construction methods (for example, addition of material, enlargement of transition radii).

### 3. Experiment Description of the Total Airframe Fatigue Experiment F 104 G

#### 3.1. Experiment Configuration

It was the purpose of the F 104 G total airframe fatigue test to test the wing structure, wing fuselage connection structure, and the central part of the fuselage in a representative way. For this purpose, 33 hydraulic cylinders with the corresponding loading frames and load introduction systems were used to introduce forces at the individual regions of the structure. Figure 1 shows an overall view of this arrangement and shows the position of the airframe in the test building.

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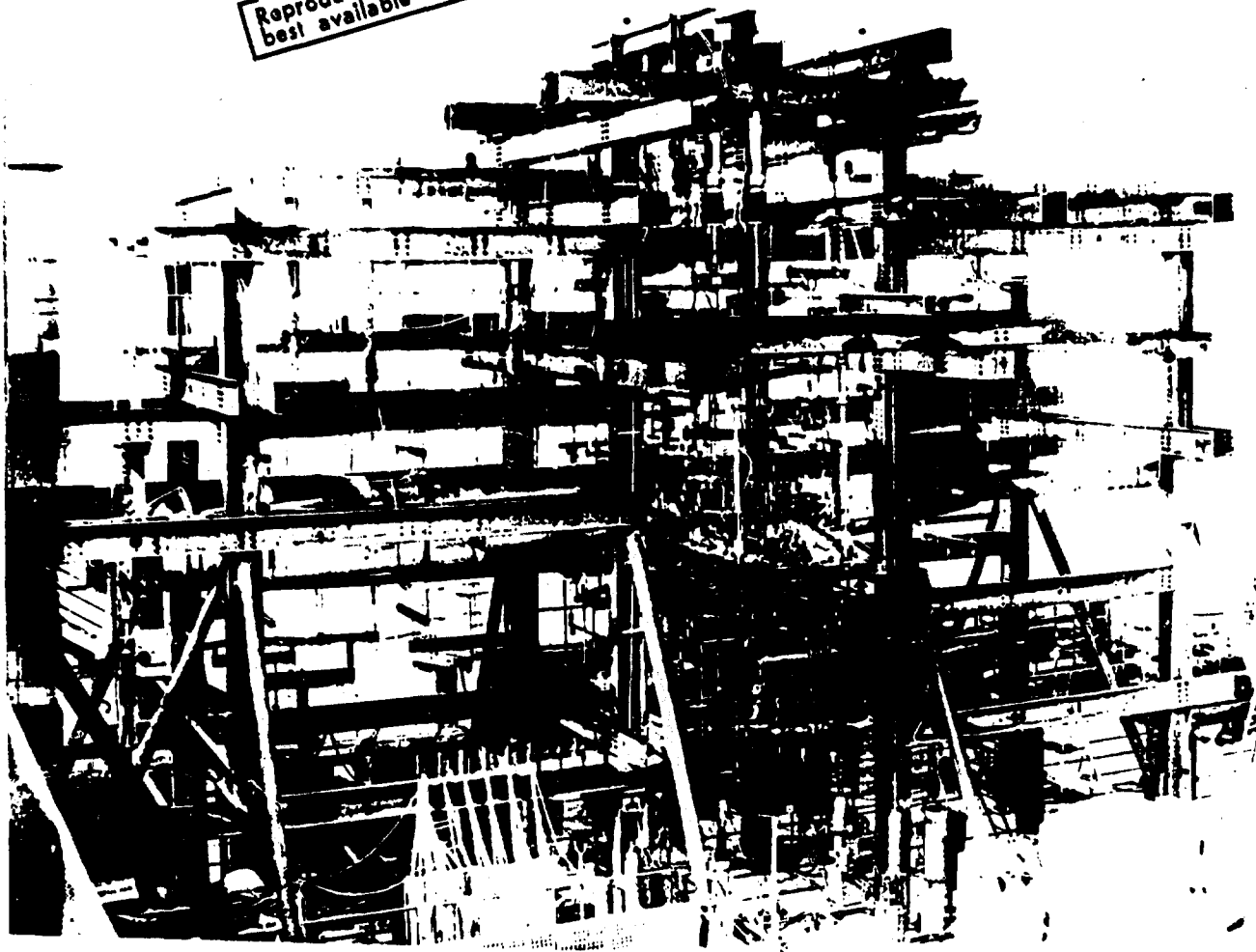


Figure 1. Overview of experimental configuration.

An original airframe was used for the test, taken from the production line.

In detail, we have the following specifications:

|                     |                             |
|---------------------|-----------------------------|
| Type                | F 104 G                     |
| Year of manufacture | 1965                        |
| Manufacturer        | Firm Fairey S. A. (Belgium) |

Serial numbers of the most important components:

|                                |                  |
|--------------------------------|------------------|
| Fuselage                       | Serial No. 113-5 |
| Original wing (left and right) | Serial No. 7210  |
| Left replacement wing          | Serial No. 2003  |
| Right replacement wing         | Serial No. 7020  |
| Left retrofit wing             | Serial No. 7210  |
| Right retrofit wing            | Serial No. 8166  |

The airframe is completely equipped according to the purpose of the experiment. The structural components not being investigated, the propulsion systems in addition to auxiliary units, the equipment, weapons, and payloads were simulated by weights or by dummies for a certain weight configuration.

The loads were applied in the form of a flight by flight program. For each of the 143 different load cases which occurred during the program, we selected the load cylinders using an electro-servo hydraulic control unit.

In conformance with the technology at the time, a punched tape was used as an information carrier for each loading case within a flight and in a sequence during the individual flights. Each load combination was stored on it. Using a cross track distributor and the corresponding control units, the hydraulic cylinders were each controlled individually. Figure 2 gives an overview of the installation.

In addition to numerous safety devices which protect the test configuration and the test object against damage, considerable amounts of equipment were used to check the test installation and to determine the strains of the test airframe.

Additional details on the structure and design of the experimental frame, the control and measurement installation, the safety installations, as well as the interactions of the individual systems can be taken from the following IABG reports:

Figure 2. Crossbar distribution panel (right) and voltage divider (left) in the supplied experimental configuration for the total airframe fatigue experiment.\*

— TF-B-81/18 Total Airframe Fatigue Experiment F 104 G,  
Test Configuration

### 3.2. Experiment Loads

In addition to the symmetric maneuver and gust loads, we simulated the takeoff/landing/load change and the rolling on the ground (taxiing) within the framework of this total airframe fatigue experiment. The total number of 143 load changes can be briefly described as follows:

- three configurations (clean 2%, tip tank 92%, tip tank and pylon tank 6% of total frequency);
- two pressure point positions
  - 22% for Ma 0.68 and 0.9
  - 45% for Ma 1.45 and Ma 0.68 with flaps/slats (15°/15°)
- ten weight distributions
- maneuver load multiple between -2.5 g and + 6.9g

Table 1 gives a summary of the load cases used.

Details on the experimental loads including the comparisons between the intersection loads obtained by computation and by experiment can be taken from the following partial report for the individual components of the structure:

— TF-B-81/9 Total Airframe Fatigue Experiment F 104 G,  
Experimental Loads, Part A to C.

\*Translator's Note: Figure missing on page 45 of German text.



TABLE 1  
SUMMARY OF LOAD CASES

| Load Case | Load Case Designation | Configuration | Mach                 | Flight Weight lbs. | Load Multiple n | Frequency of Load Cases per 1000 fl.hrs. |       |
|-----------|-----------------------|---------------|----------------------|--------------------|-----------------|--|-------|
|           |                       |               |                      |                    |                 | MFG                                      | TCTP  |
| 1         | FQT 5/1/1.5           | Tiptank       | 0,68<br>C.P.*<br>22% | 22 700             | 1.49            | 302                                      | 417   |
| 2         | FQT 5/1/2.0           |               |                      |                    | 2.00            | 206                                      | 248   |
| 3         | PQT 5/1/3.0           |               |                      |                    | 2.95            | 51                                       | 87    |
| 4         | PQT 5/1/4.0           |               |                      |                    | 4.00            | 22                                       | 22    |
| 5         | PST 5/1/1.5           |               |                      |                    | 1.49            | 7473                                     | 6605  |
| 6         | PST 5/1/2.0           |               |                      |                    | 2.00            | 391                                      | 465   |
| 7         | PST 5/1/3.0           |               |                      |                    | 2.95            | 537                                      | 744   |
| 8         | PST 5/1/4.0           |               |                      |                    | 4.00            | 86                                       | 241   |
| 9         | NST 5/1/0.3           |               |                      |                    | 0.33            | 8142                                     | 7728  |
| 10        | NST 5/1/0.0           |               |                      |                    | 0.05            | 324                                      | 324   |
| 11        | NST 5/1/1.0           |               |                      |                    | 1.03            | 3  | 3     |
| 12        | PQT 6/1/1.5           | Tiptank       | 0,68<br>C.P.*<br>22% | 21 300             | 1.50            | 419                                      | 581   |
| 13        | PQT 6/1/2.0           |               |                      |                    | 2.03            | 286                                      | 344   |
| 14        | PQT 6/1/3.0           |               |                      |                    | 3.00            | 71                                       | 120   |
| 15        | PQT 6/1/4.0           |               |                      |                    | 3.95            | 30                                       | 30    |
| 16        | PST 6/1/1.5           |               |                      |                    | 1.50            | 10770                                    | 9583  |
| 17        | PST 6/1/2.0           |               |                      |                    | 2.03            | 587                                      | 691   |
| 18        | PST 6/1/3.0           |               |                      |                    | 3.00            | 765                                      | 1054  |
| 19        | PST 6/1/4.0           |               |                      |                    | 3.95            | 126                                      | 341   |
| 20        | PST 6/1/5.0           |               |                      |                    | 4.97            | 25                                       | 52    |
| 21        | NST 6/1/0.5           |               |                      |                    | 0.50            | 11793                                    | 11263 |
| 22        | NST 6/1/0.0           |               |                      |                    | -0.03           | 474                                      | 452   |
| 23        | NST 6/1/1.0           |               |                      |                    | -0.99           | 4  | 4     |
| 24        | NST 6/1/2.5           |               |                      |                    | -2.51           | 2  | 2     |
| 25        | PQT 7/1/1.5           | Tiptank       | 0,68<br>C.P.*<br>22% | 19 900             | 1.49            | 419                                      | 581   |
| 26        | PQT 7/1/2.0           |               |                      |                    | 1.98            | 286                                      | 344   |
| 27        | PQT 7/1/3.0           |               |                      |                    | 3.02            | 71                                       | 120   |
| 28        | PQT 7/1/4.0           |               |                      |                    | 4.04            | 30                                       | 30    |
| 29        | PST 7/1/1.5           |               |                      |                    | 1.49            | 10754                                    | 9566  |
| 30        | PST 7/1/2.0           |               |                      |                    | 1.98            | 586                                      | 690   |
| 31        | PST 7/1/3.0           |               |                      |                    | 3.02            | 766                                      | 1055  |
| 32        | PST 7/1/4.0           |               |                      |                    | 4.04            | 125                                      | 340   |
| 33        | PST 7/1/5.0           |               |                      |                    | 5.00            | 25                                       | 51    |
| 34        | NST 7/1/0.6           |               |                      |                    | 0.57            | 11775                                    | 11244 |
| 35        | NST 7/1/0.0           |               |                      |                    | 0.01            | 475                                      | 452   |
| 36        | NST 7/1/2.0           |               |                      |                    | -1.03           | 4  | 4     |
| 37        | NST 7/1/2.5           |               |                      |                    | -2.51           | 2  | 2     |
| 38        | PQT 8/1/1.5           | Tiptank       | 0,68<br>C.P.*<br>22% | 18 500             | 1.51            | 419                                      | 581   |
| 39        | PQT 8/1/2.0           |               |                      |                    | 1.90            | 286                                      | 344   |
| 40        | PQT 8/1/3.0           |               |                      |                    | 3.08            | 71                                       | 120   |
| 41        | PQT 8/1/4.0           |               |                      |                    | 4.15            | 30                                       | 30    |
| 42        | PST 8/1/1.5           |               |                      |                    | 1.51            | 10785                                    | 9598  |
| 43        | PST 8/1/2.0           |               |                      |                    | 1.99            | 588                                      | 692   |
| 44        | PST 8/1/3.0           |               |                      |                    | 3.08            | 766                                      | 1055  |
| 45        | PST 8/1/4.0           |               |                      |                    | 4.15            | 126                                      | 341   |
| 46        | PST 8/1/5.0           |               |                      |                    | 5.10            | 25                                       | 52    |

TABLE 1 (Continued)

| Load Case | Load Case Designation | Configuration | Mach                 | Flight Weight lbs. | Load Multiple n | Frequency of Load Cases per 1000 fl.hrs. |       |
|-----------|-----------------------|---------------|----------------------|--------------------|-----------------|--|-------|
|           |                       |               |                      |                    |                 | MFG                                      | TCTP  |
| 47        | NST 8/1/0.3           | Tiptank       | 0.68<br>C.P.=<br>22% | 17 100             | 0.33            | 11811                                    | 11281 |
| 48        | NST 8/1/0.0           |               |                      |                    | 0.06            | 474                                      | 452   |
| 49        | NST 8/1/1.0           |               |                      |                    | -0.97           | 5  | 5     |
| 50        | NST 8/1/2.7           |               |                      |                    | -2.68           | 0  | 0     |
| 51        | PQT10/1/1.6           |               |                      |                    | 1.59            | 391                                      | 540   |
| 52        | PQT10/1/2.0           |               |                      |                    | 1.98            | 266                                      | 320   |
| 53        | PQT10/1/3.0           |               |                      |                    | 3.00            | 66                                       | 113   |
| 54        | PQT10/1/4.0           |               |                      |                    | 4.05            | 28                                       | 28    |
| 55        | PST10/1/1.6           |               |                      |                    | 1.59            | 9975                                     | 8855  |
| 56        | PST10/1/2.0           |               |                      |                    | 1.98            | 542                                      | 636   |
| 57        | PST10/1/3.0           |               |                      |                    | 3.00            | 712                                      | 978   |
| 58        | PST10/1/4.0           |               |                      |                    | 4.05            | 116                                      | 316   |
| 59        | NST10/1/0.4           | Tiptank       | 0.68<br>C.P.=<br>45% | 21 300             | 0.42            | 10900                                    | 10362 |
| 60        | NST10/1/0.0           |               |                      |                    | 0.01            | 441                                      | 419   |
| 61        | NST10/1/1.0           |               |                      |                    | -1.01           | 4  | 4     |
| 62        | PKT 5/1/2.0           |               |                      |                    | 1.99            | 334                                      | 403   |
| 63        | PKT 5/1/3.0           |               |                      |                    | 2.97            | 126                                      | 229   |
| 64        | PKT 5/1/4.0           |               |                      |                    | 4.14            | 80                                       | 125   |
| 65        | PKT 6/1/2.0           |               |                      |                    | 2.00            | 462                                      | 559   |
| 66        | PKT 6/1/3.0           |               |                      |                    | 2.94            | 174                                      | 295   |
| 67        | PKT 6/1/4.1           |               |                      |                    | 4.091           | 112                                      | -     |
| 67        | PKT 6/1/4.4           |               |                      |                    | 4.37            | -  | 185   |
| 68        | PKT 6/1/5.0           |               |                      |                    | 5.07            | 40                                       | 50    |
| 69        | PKT 7/1/2.0           | Tiptank       | 0.68<br>C.P.=<br>45% | 19 900             | 2.01            | 462                                      | 559   |
| 70        | PKT 7/1/3.0           |               |                      |                    | 2.98            | 174                                      | 295   |
| 71        | PKT 7/1/3.9           |               |                      |                    | 3.925           | 112                                      | -     |
| 71        | PKT 7/1/4.5           |               |                      |                    | 4.45            | -  | 185   |
| 72        | PKT 7/1/5.1           |               |                      |                    | 5.10            | 40                                       | 50    |
| 73        | PKT 8/1/2.0           |               |                      | 18 500             | 2.01            | 462                                      | 559   |
| 74        | PKT 8/1/3.0           |               |                      |                    | 3.01            | 174                                      | 295   |
| 75        | PKT 8/1/4.0           |               |                      |                    | 3.987           | 112                                      | -     |
| 75        | PKT 8/1/4.3           |               |                      |                    | 4.29            | -  | 185   |
| 76        | PKT 8/1/4.9           |               |                      |                    | 4.86            | 40                                       | 50    |
| 77        | PKT10/1/2.0           |               |                      | 17 100             | 1.99            | 430                                      | 520   |
| 78        | PKT10/1/3.0           |               |                      |                    | 2.93            | 162                                      | 286   |
| 79        | PKT10/1/3.9           |               |                      |                    | 3.893           | 104                                      | -     |
| 79        | PKT10/1/4.4           |               |                      |                    | 4.40            | -  | 170   |
| 80        | PST 5/2/1.5           | Tiptank       | 0.9<br>C.P.=<br>22%  | 22 700             | 1.49            | 463                                      | 376   |
| 81        | PST 5/2/2.0           |               |                      |                    | 2.06            | 87                                       | 127   |
| 82        | PST 5/2/3.0           |               |                      |                    | 2.99            | 93                                       | 111   |
| 83        | PST 5/2/4.0           |               |                      |                    | 4.00            | 17                                       | 44    |
| 84        | NST 5/2/0.3           |               |                      |                    | 0.30            | 658                                      | 656   |
| 85        | NST 5/2/0.5           |               |                      |                    | -0.47           | 2  | 2     |
| 86        | PST 6/2/1.5           |               |                      | 22 700             | 1.48            | 1295                                     | 1051  |
|           |                       |               |                      |                    |                 |  |       |
|           |                       |               |                      |                    |                 |  |       |
|           |                       |               |                      |                    |                 |  |       |
|           |                       |               |                      |                    |                 |  |       |

TABLE 1 (Continued)

| Load Case | Load Case Designation | Configuration       | Mach                        | Flight Weight lbs. | Load Multiple n | Frequency of Load Cases per 100 fl.hrs. |      |
|-----------|-----------------------|---------------------|-----------------------------|--------------------|-----------------|---|------|
|           |                       |                     |                             |                    |                 | MFG                                     | TCTP |
| 97        | PST 6/2/2.0           | Tiptank             | 0.9<br>C.P.*<br>22%         | 21 300             | 2.02            | 244                                     | 356  |
| 98        | PST 6/2/3.0           |                     |                             |                    | 2.97            | 260                                     | 311  |
| 99        | PST 6/2/4.0           |                     |                             |                    | 4.01            | 47                                      | 123  |
| 100       | PST 6/2/5.0           |                     |                             |                    | 5.00            | 5                                       | 15   |
| 101       | NST 6/2/0.4           |                     |                             |                    | 0.36            | 1842                                    | 1847 |
| 102       | NST 6/6/2.6           |                     |                             | 21 300             | -0.56           | 8                                       | 8    |
| 103       | NST 6/2/1.5           |                     |                             |                    | -1.45           | 1                                       | 1    |
| 104       | PST 7/2/1.5           |                     |                             | 19 900             | 1.51            | 1434                                    | 1163 |
| 105       | PST 7/2/2.0           |                     |                             |                    | 2.03            | 271                                     | 394  |
| 106       | PST 7/2/3.0           |                     |                             |                    | 3.00            | 287                                     | 344  |
| 107       | PST 7/2/4.0           |                     |                             |                    | 4.00            | 52                                      | 137  |
| 108       | PST 7/2/5.0           |                     |                             |                    | 5.00            | 7                                       | 17   |
| 109       | NCT 7/2/0.5           | 0.41                | 2039                        |                    | 2043            |   |      |
| 110       | NST 7/2/0.5           | -0.46               | 8                           |                    | 8               |   |      |
| 111       | NST 7/2/1.5           | 19 900              | -1.54                       |                    | 2               | 2                                       |      |
| 112       | NST 7/2/2.0           |                     | -2.09                       | 2                  | 2               |   |      |
| 113       | PST 8/2/1.5           | Tiptank             | 0.9<br>C.P.*<br>22%         | 18 500             | 1.49            | 1156                                    | 938  |
| 114       | PST 8/2/2.0           |                     |                             |                    | 1.93            | 218                                     | 317  |
| 115       | PST 8/2/3.0           |                     |                             |                    | 3.02            | 232                                     | 278  |
| 116       | PST 8/2/4.0           |                     |                             |                    | 4.05            | 42                                      | 110  |
| 117       | PST 8/2/5.0           |                     |                             |                    | 5.00            | 5                                       | 13   |
| 118       | NST 8/2/0.2           |                     |                             | 0.19               | 1644            | 1647                                    |      |
| 119       | NST 8/2/0.5           |                     |                             | -0.47              | 8               | 8                                       |      |
| 120       | NST 8/2/1.5           |                     |                             | 18 500             | -1.52           | 1                                       | 1    |
| 121       | PST 10/2/1.5          |                     |                             |                    | 1.49            | 1481                                    | 1201 |
| 122       | PST 10/2/2.0          | 17 100              | 1.97                        | 280                | 406             |   |      |
| 123       | PST 10/2/2.9          |                     | 2.89                        | 298                | 356             |   |      |
| 124       | PST 10/2/3.9          |                     | 3.88                        | 55                 | 141             |   |      |
| 125       | NST 10/2/0.3          |                     | 0.23                        | 2105               | 2096            |   |      |
| 126       | NST 10/2/0.5          |                     | -0.50                       | 9                  | 8               |   |      |
| 127       | PSC 7A/3/1.7          | clean               | 1.45<br>0.9<br>C.P.*<br>45% | 19 150             | 1.71            | 109                                     | 109  |
| 128       | PSC 7A/3/3.0          |                     |                             |                    | 2.93            | 22                                      | 22   |
| 129       | NBC 7A/3/0.5          |                     |                             |                    | 0.53            | 131                                     | 131  |
| 130       | PSC 8/2/2.0           | clean               | 0.9<br>C.P.*<br>22%         | 18 500             | 1.99            | 1121                                    | 1121 |
| 131       | PSC 8/2/4.5           |                     |                             |                    | 4.51            | 59                                      | 59   |
| 132       | PSC 8/2/6.9           |                     |                             |                    | 6.87            | 1                                       | 1    |
| 133       | NSC 8/2/0.5           |                     |                             |                    | 0.47            | 1174                                    | 1174 |
| 134       | NSC 8/2/0.0           | Tip- and Pylon-tank | 0.68<br>C.P.*<br>22 %       | 25 700             | -0.05           | 7                                       | 7    |
| 135       | PSP 2/1/1.5           |                     |                             |                    | 1.48            | 275                                     | 275  |
| 136       | PSP 2/1/2.0           |                     |                             |                    | 2.08            | 30                                      | 30   |
| 137       | PSP 2/1/3.0           |                     |                             |                    | 3.01            | 16                                      | 16   |
| 138       | NSP 2/1/0.4           |                     |                             |                    | 0.44            | 321                                     | 321  |

TABLE 1 (Continued)

| Load Case | Load Case Designation | Configuration      | Mach            | Flight Weight lbs. | Load Multiple n | Frequency of Load Cases per 100 fl.hrs. |       |
|-----------|-----------------------|--------------------|-----------------|--------------------|-----------------|---|-------|
|           |                       |                    |                 |                    |                 | MFG                                     | TCTP  |
| 129       | PSP 3/1/1.5           |                    |                 | 24 100             | 1.50            | 455                                     | 455   |
| 130       | PSP 3/1/2.0           |                    |                 |                    | 2.01            | 50                                      | 50    |
| 131       | PSP 3/1/3.0           |                    |                 |                    | 2.97            | 24                                      | 24    |
| 132       | PSP 3/1/4.0           |                    |                 | 3.96               | 8               | 8                                       |       |
| 133       | NSP 3/1/0.4           |                    |                 | 24 100             | 0.41            | 537                                     | 537   |
| 134       | PSP 5/1/1.5           | Tip- and Pylontank | 0.68 C.P. = 22% | 22 700             | 1.51            | 422                                     | 422   |
| 135       | PSP 5/1/2.0           |                    |                 |                    | 2.0             | 46                                      | 46    |
| 136       | PSP 5/1/3.1           |                    |                 |                    | 3.10            | 22                                      | 22    |
| 137       | PSP 5/1/4.1           |                    |                 |                    | 4.13            | 8                                       | 8     |
| 138       | PSP 5/1/5.1           |                    |                 |                    | 5.16            | 2                                       | 2     |
| 139       | NSP 5/1/0.4           |                    |                 |                    | 0.44            | 500                                     | 500   |
| 140       | RT 4/0/0.33           | Tiptank            |                 | 23 500             | 0.33            | 11115                                   | 11115 |
| 141       | RT 4/0/1.66           |                    |                 |                    | 1.67            | 11115                                   | 11115 |
| 142       | RP 1/0/0.33           | Tip- and Pylontank | 0.0             | 26 500             | 0.33            | 555                                     | 555   |
| 143       | RP 1/0/1.66           |                    |                 |                    | 1.67            | 555                                     | 555   |
| 144       |                       | 0.68 C.P. = 22%    |                 |                    | 21 300          | 0.84                                    |       |
| 145       |                       | 0.68 C.P. = 45%    |                 |                    |                 |   |       |

### 3.3. Experimental Program

The experimental program is based on four main missions which can be characterized as follows:

— mission 1 625 flight hours  
 low-low-low  
 ma = 0.68  
 tip tank — configuration

— mission 2 295 flight hours  
 high-high-high  
 Ma = 0.9  
 tip tank — configuration

— mission 3 60 flight hours  
test flight  
Ma = 0.9/1.45  
Clean — configuration

— mission 4 20 flight hours  
high-high-high and  
low-low-low  
Ma = 0.68  
tip and pylon tank — configuration

The flight hours given above are the fractions which are contained within a partial sequence of the test program which lasted 1000 flight hours. These 1000 flight hours correspond to 803 characteristic flights and each flight consists of 203 load multiples on the average. For each flight, about 75 load changes correspond to gusts and maneuvers.

The relationship between the missions and configurations, respectively, and the load states can be found from Figure 3. Figure 4 shows the MFG total spectrum. The percentage composition of this spectrum and the initial data used can be found from Table 2. The marine aviation wing spectrum (abbreviation MFG) was simulated for up to 1000 test hours.

A change in the tactical use of the aircraft at that time led one to the conclusion that this would result in a more severe load on the airframe. Therefore, the so-called tactical combat training procedure (abbreviation TCTP) spectrum was estimated, which is also shown in Figure 4.

The order of the individual load cases within a flight is partially deterministic according to a mission and partially stochastic. The sequence of the individual flights was selected so that the mix of the program sequence was as uniform as possible.

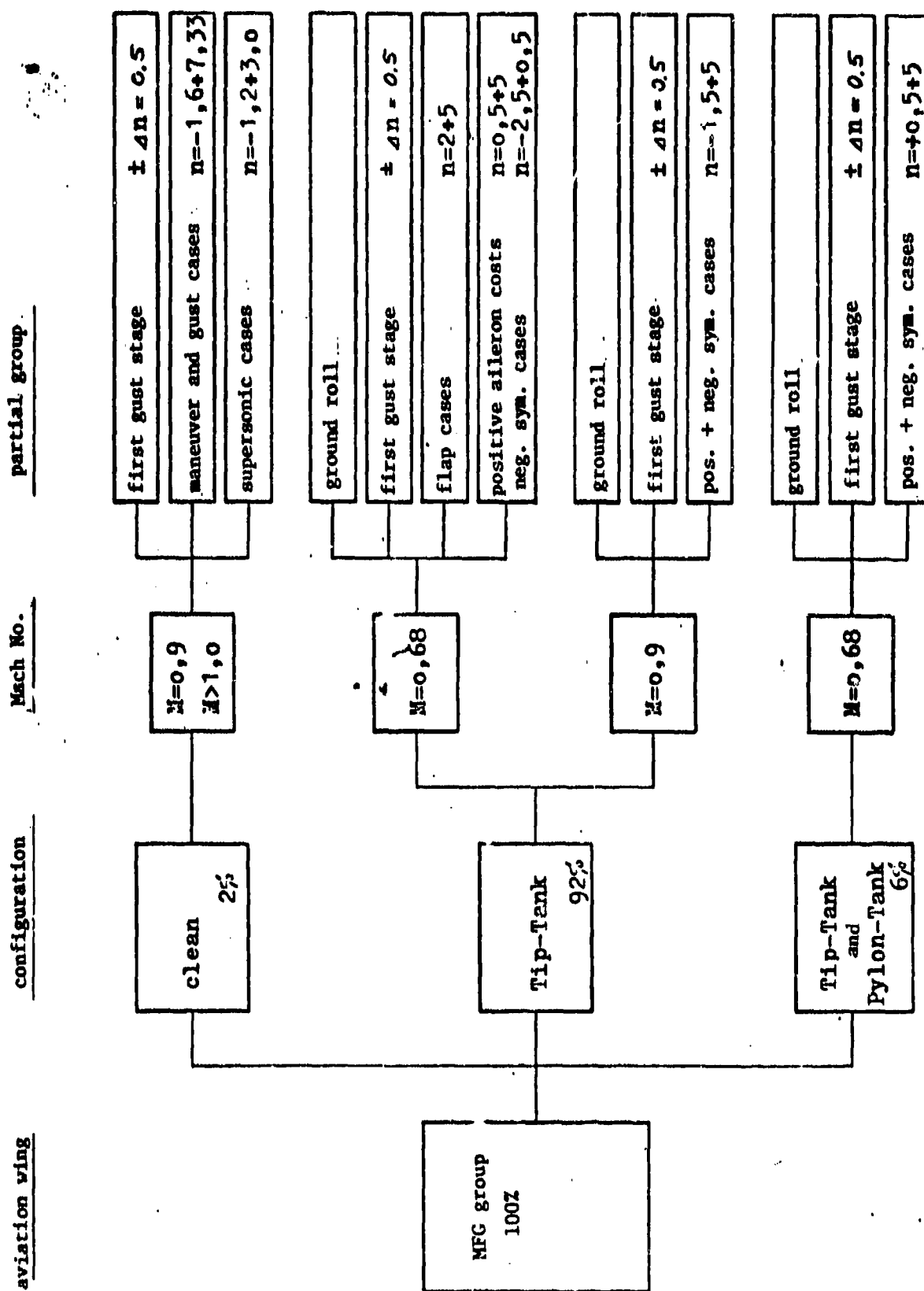


Figure 3. Structure of the MFG (Marine Aviation Wing Spectrum) group.

Figure 4. Overall test programs MFG and TCTP.

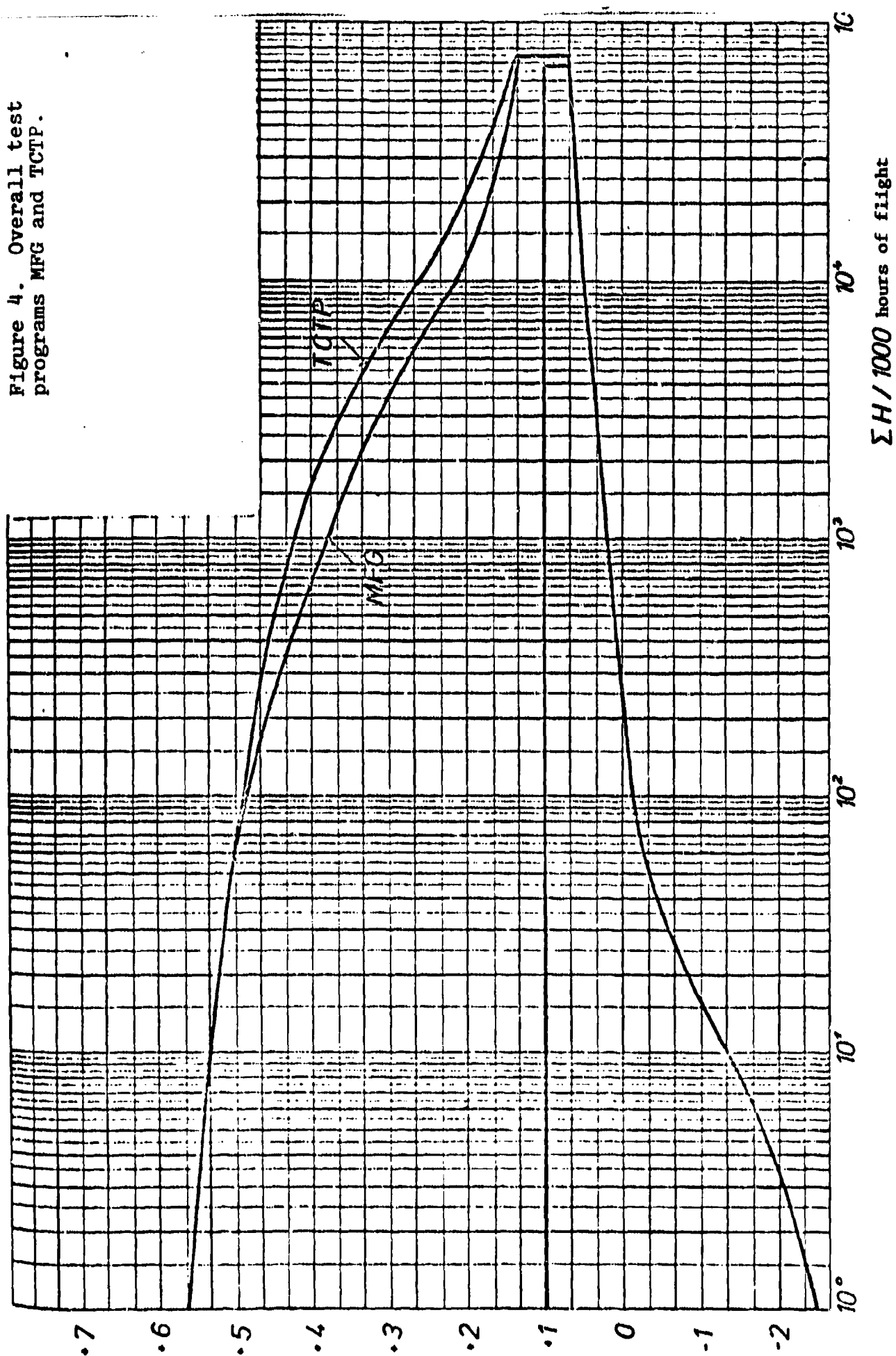


TABLE 2  
CORRESPONDENCE OF FREQUENCY DISTRIBUTIONS AND FLIGHT MISSIONS FOR THE MARINE AVIATION  
WING SPECTRUM IN PERCENT OF TOTAL FLIGHT TIME

|                           | MISSION   |  |  |   |
|---------------------------|---|--|--|---|
|                           | High-High-High  | Low-Low-Low  | High-High-High<br>Low-Low-Low                                | Test Flight   |
|                           | Config. T. T.<br><br>Ma. 0.9<br>Flight time:<br>29.5% | Config. T. T.<br><br>Ma. 0.68<br>Flight time:<br>62.5% | Config. T. T.<br>and P. T.<br>Ma. 0.68<br>Flight time:<br>6% | Config. CLEAN<br><br>Ma. 0.9/1.45<br>Flight time:<br>2% |
| Frequency<br>Distribution |   |  |  |   |
| Reconnaissance**          | 7.5   |  | 6.0  |   |
| Air tactics***            | 22.0  | 30.0   |  |   |
| Convent. bombing***       |   | 32.0   |  |   |
| Test Flight***            |   |  |  | 2.0*  |
| TOTAL                     | 29.5  | 62.5   | 6.0  | 2.0   |

\*Of this, 1.8% in the subsonic and 0.2% in the supersonic range.

\*\*LBF data

\*\*\*F-4C flight measurement.



Figure 5 shows the sequence for a typical flight within the 803 flights. The bending moment at the root is used as a reference. Detailed data on the structure of the loading program are contained in the following IABG report:

- TF-B-81/10 Total Airframe Fatigue Experiment F 104 G  
Load Program

#### 4. Results

##### 4.1. Results of Preliminary Investigations

The influences of maneuver flaps and aileron deflection on the stress distribution in the supporting part of the wing assembly was investigated with individual components of the F 104 G in order to establish the experimental concept. The results are contained in the following reports:

- 81/01 and 81/02 Fatigue Strength Demonstration F 104 G  
Influence of Flap Deflection on the Stress  
Distribution in the Wing
- 81/07 Fatigue Experiment Demonstration F 104 G  
Influence of Aileron Deflections on the  
Stress Distribution in the Wing

After the fracture of the wing assembly, which started at WS 80.7 and occurred at the hatch, led to the loss of an aircraft and after we found damage in this region in additional operational aircraft and during fatigue experiments, we questioned the influence of the deployed landing flaps on the stress distribution in this region. It was important to clarify this question because, during the fatigue experiments, we simulated only the loads but not the deployment of the flaps. On the other hand, during deployments with the hatch, we performed the flights with a considerably higher fraction of flap operation.

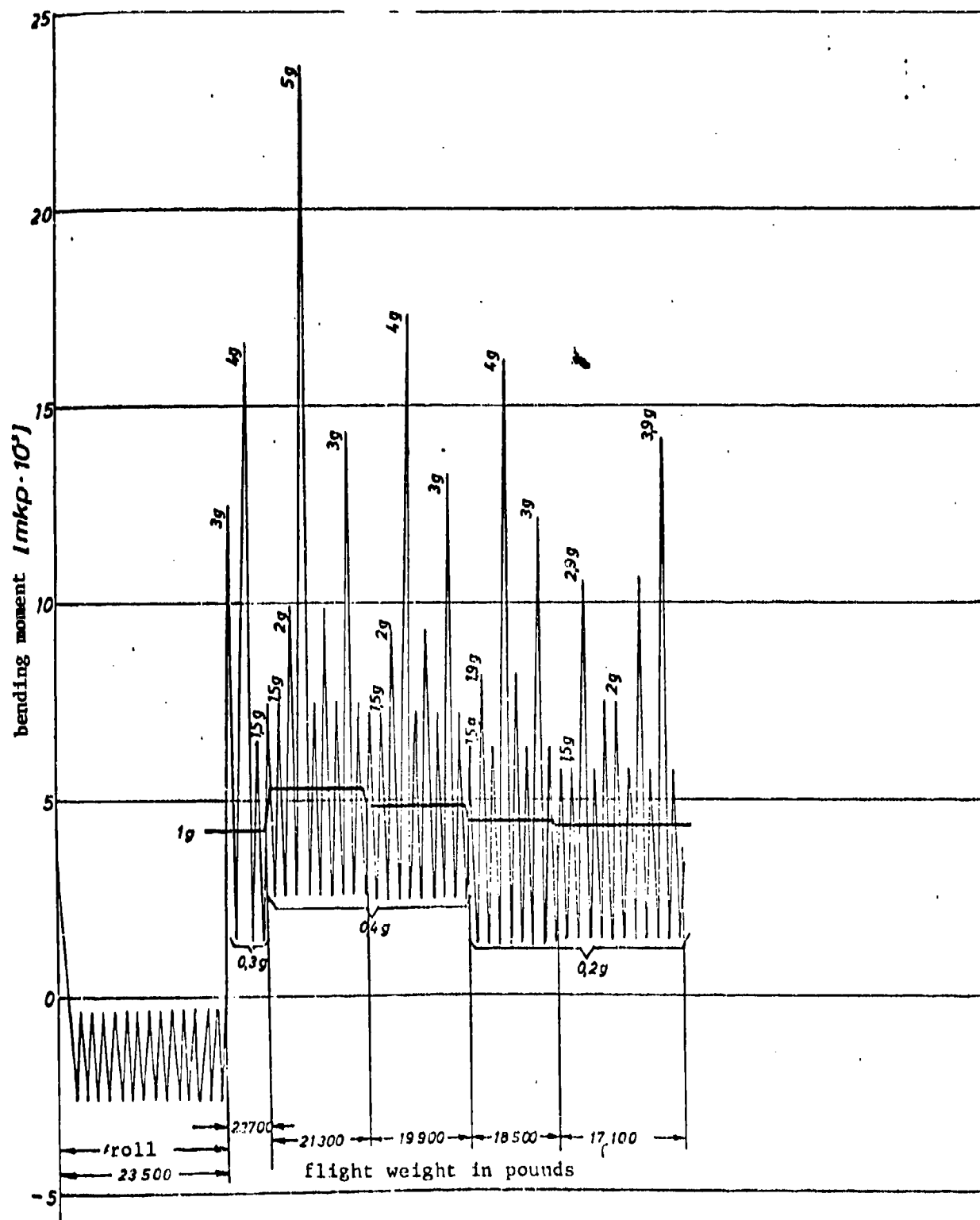


Figure 5. Bending moment variation along wing root during flight No. 25, high-high-high mission with  $Ma = 0.9$ , tip tank configuration.

The results of these additional measurements, which extend to the rear spar range and the wing root, are contained in the following report:

— TF 81/06 Total Airframe Fatigue Experiment F 104 G  
Stress Analysis Flap Deflections

The result of this investigation can be summarized as follows:

— Usually one did not find a unified tendency in the change of the stress distribution when the flap was extended. Because of the small contribution of the flap cases in the TCTP collective, it is not necessary to correct the results of the total airframe fatigue experiment if the flaps are not deployed.

The measurement results obtained from the stress analysis showed that a pressure point change from the front ( $c_p = 22\%$ ) to the back ( $c_p = 45\%$ ), such as occurs when the flaps are operated, has a considerable negative influence on the stress distribution, in particular in the area of the wing root, and therefore also on the lifetime.

Special load introduction elements were developed to introduce the forces to the wing structure. Sometimes this led to a modification or weakening of the surrounding structure. In preliminary experiments, we were able to show that the changes made in these regions did not influence the lifetime, i.e., they do not fracture before the structure itself. The results of this investigation are contained in the following reports:

- TF 81/03 Total Airframe Fatigue Experiment F 104 G  
Lifetime Improvement by Coining
- TF 81/04 Total Airframe Fatigue Experiment F 104 G  
Wing Load Introduction

These results were subsequently confirmed, because no damage was found in the load introduction point during the fatigue experiment.

#### 4.2. Stress Measurements

In order to determine the overall stress level, we determined the strains and stresses using strain gauges in all of the load bearing structures (primarily wing assemblies). After damage had occurred to an increased degree, we carried out additional instrumentation placement in order to be able to determine the local stress conditions in a better way and in order to be able to interpret them.

Before the beginning of the experiment with the retrofit wings, we carried out a small stress analysis in the region of the modified structure in order to obtain reference points on the influence of the modification. Detailed data and results of these investigations are contained in the following reports:

- TF 81/08 Total Airframe Fatigue Experiment F 104 G  
Arrangement of the Strain Gauges in the  
Fuselage and Wing, Parts A and B
- TF 81/11 Total Airframe Fatigue Experiment F 104 G  
Stress Analysis, Parts A and B
- TF 81/12 Total Airframe Fatigue Experiment F 104 G  
Stress Analysis Retrofit Wing

The stress measurements resulted in stresses along the lower shell of the wing root region (WS 48) of about +22 to 25 kg/mm<sup>2</sup> in the maximum load cases of the load program. The nominal stresses in the region of the pylon plane were only slightly smaller. In the region of disturbances and discontinuities, we sometimes measured considerably higher values.

An evaluation of the stress analysis of the retrofit/basic wing, mentioned in particular in the last report, showed that a stress reduction of about 15% occurs in the reinforced region of the lower wing skin of the retrofit wing at WS 47, which is a reference value.

At WS 48, this is about 20% and at the tapering in the reinforced region, it is about 30%.

In the transition range where there is thicker material, stresses occur in the unreinforced area of the retrofit wing, which are about 15% higher (because of additional bending). In the pylon fitting connection, they are about 7% lower and there are no significant differences at the pylon manifold.

#### 4.3. Additional Investigations

It was sometimes necessary to test and develop special methods for recognizing cracks and monitoring them. In addition to the extensive breaking wire instrumentation, we also investigated the possibility of monitoring the occurrence and propagation of cracks using strain gauges. The results of such an investigation are contained in the following report:

- TF 81/05 Total Airframe Fatigue Experiment F 104 G  
Single Stage Experiment in a Drilled Probe  
Rod for Testing Crack Recognition Method  
Using Strain Gauges.

After the total airframe fatigue experiment had demonstrated the first structural damage, it became necessary to develop special crack test methods for the damage encountered during the fatigue experiment, as well as special methods for monitoring the operational aircraft. The first work was done within the framework of the F 104 G total airframe fatigue experiment project. The following report contains the investigation on a special eddy current crack test method:

- 81/22 Eddy Current Crack Test Method I  
For Main Wing F 104, Fitting 5, Bolt Hole 12

Additional special investigations required at the time were performed within the framework of separate requests. These investigations were concerned with the development of special test procedures, the production and manufacture of special equipment and the establishment of specifications for the troop personnel and their instruction.

The damage which occurred relatively early, in particular at the wing connection fittings, required structural improvements of the structures in this region. The material was made thicker in order to drop the stress level, and also other alloys were selected which have better static residual strength and which are more favorable with respect to the stress crack corrosion which we found. The additional investigations of these measures were also primarily performed within the framework of additional requests.

A few investigations, such as for example, the testing of the change-over from fitting alloy 7079 T6 (old forging) to a new forging method, or to the alloy AZ 74, were carried out within the framework of the total airframe fatigue experiment. The results are contained in the following report:

— TF 81/16 Total Airframe Fatigue Experiment F 104 G  
Fitting Probe Rod Experiments

#### 4.4. Damage During the Fatigue Experiment

##### 4.4.1. Damage summary

The structural damage which occurred within the F 104 G total airframe fatigue experiment was discussed in detail in the eleven damage reports having the numbers TF-B-81/21.1 to TF-B-81/21.11. The exact titles of the reports are given in Table A1 in Appendix A of this report. Appendix B of this report contains a summary of all the damage found on the structure. It is given in the form of a table and is structured as follows:

|          |  |
|----------|--|
| Table B1 | Damage to the Unreinforced Basic Wings<br>(up to 8,687 total test hours)           |
| Table B2 | Damage to the Retrofit Wings<br>(tested between 8,687 and 14,869 total test hours) |
| Table B3 | Damage to the Fuselage Structure<br>(tested up to 14,869 total test hours).        |

In this summary, we again given the damage report in which a detailed description of the damage is given, as well as possible notes about changes, repairs, and other measures taken.

Within the framework of the F 104 G total airframe fatigue experiment, about 2420 damages and initial cracks were found, which can be classified as follows:

- wing fuselage connection fittings (basic and retrofit) about 250
- lower skin (basic and retrofit) about 720
- wing inner components (spar and ribs) about 1300
- fuselage damage about 150

#### 4.4.2. Classification of the damage

After conclusion of the total airframe fatigue experiment, we carried out a simple global classification of all the damage which occurred. It is also given in the last column of Tables 1 — 3 in Appendix B. These categories are a measure for the significance of the individual cracks and fractures, according to the present state of knowledge.

It should be noted that such correspondences are only possible for a certain limited span of time; in the case discussed here, this is up to a minimum lifetime for the individual components given under point 5.

## Category X

Damage in the form of cracks or fractures which would lead to catastrophic effects within a relatively limited time frame and which could directly influence the flight safety. The damage locations should be inspected in detail at special specified inspection intervals after certain numbers of flight hours have elapsed, and they should also be covered within the framework of disturbance announcement methods. Damaged parts must be immediately replaced.

### CATEGORY X — WING DAMAGE (see also Figure 6)

| Damage No.  | Report No. | Wing* | Damage Location   |
|---|------------|-------|---|
| F10, F12,<br>F13, F14,<br>F15, F22,<br>F28, F42,<br>F46, F67,<br>F68, F64 | 81/21.8    | B     | wing connection<br>fittings (fittings)                            |
| RF4, RF5,<br>RF6, RF7,<br>RF8, RF9,<br>RF10, RF11,<br>RF12, RF16          | 81/21.9    | R     | wing connection<br>fittings (fittings)                            |
| F40, F44  | 81/21.4    | B     | lower wing skin<br>pylon fitting con-<br>nection                  |
| RF21, RF22  | 81/21.5    | R     | (WS 63.7 WS 66)   |
| F1, F31   | 81/21.4    | B**   | lower wing skin,<br>opening for the<br>aileron servo<br>(WS 80.7) |
| F 49  | 81/21.4    | B     | lower wing skin<br>pylon manifold                                 |
| RF15, RF41  | 81/21.5    | R     | (WS 73.5)   |

\*B = basic wing, R = retrofit wing

\*\*In the meantime, the opening has been closed.

### Category X — Fuselage Damage

No damage in the category X occurred for the fuselage.



wing structure F 104 G and TF 104 G

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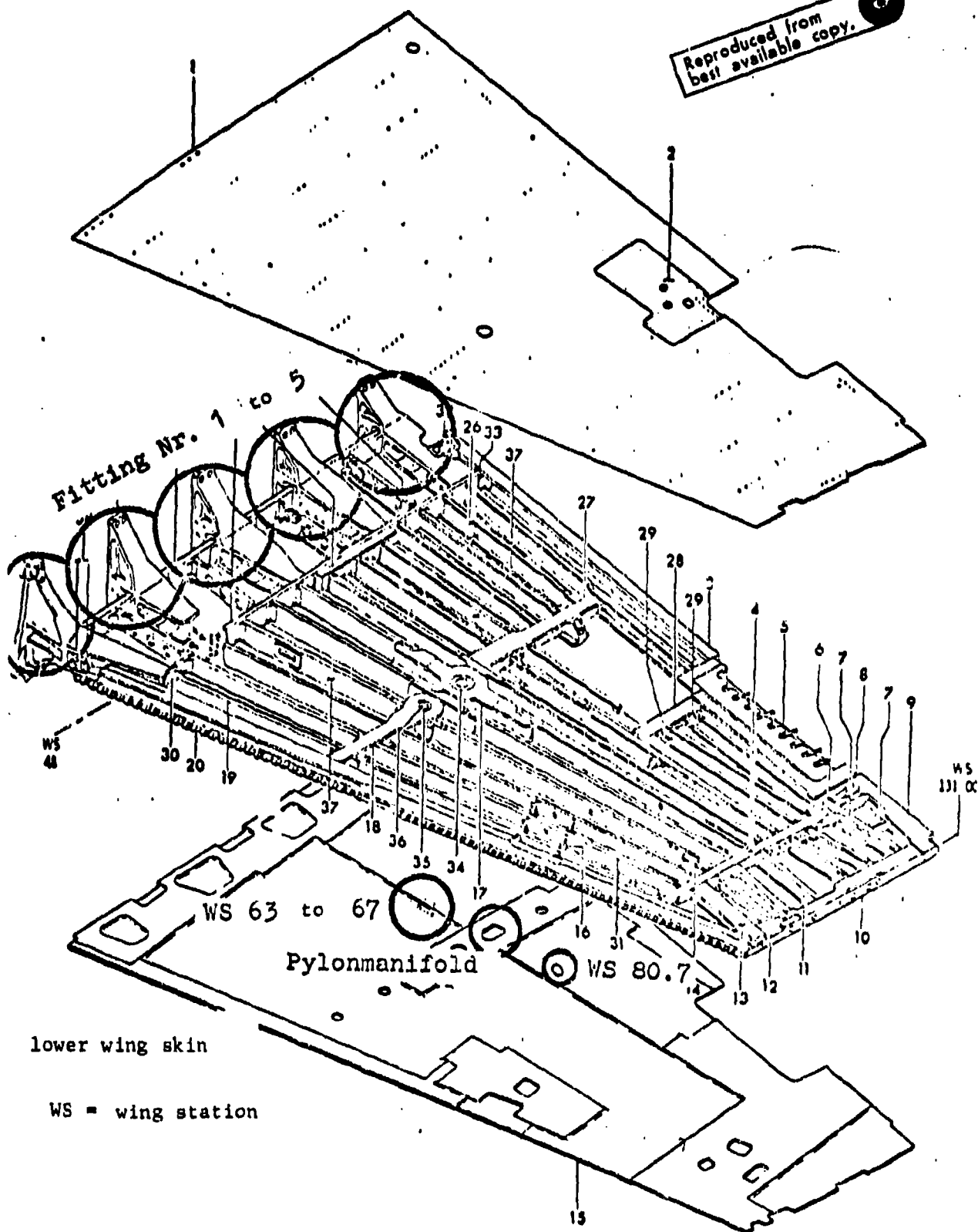


Figure 6. Summary of wing damage of category X.

### Category A

Damage which could endanger flight safety if it increased and which was determined during the total airframe fatigue test and partially in the operational aircraft. This possible type of damage should be thoroughly inspected during any change maintenance activity; the damage should be covered within the framework of the disturbance announcement procedure and should be repaired according to TO 1F-104G-3, or special instructions. A critical crack propagation between two change maintenance procedures is not required according to the present state of knowledge.

### Category B

Damage which, in principle, corresponds to the damage specified as category A and which was first only determined within the framework of the total airframe fatigue test. In the case where this occurs in troop aircraft, it should be treated just as under category A as a precaution, i.e., there should be a thorough inspection during any change maintenance activity.

As can be seen from the definitions for categories A and B given above, these categories only differ by the fact that, in one case, information is available on the damage which occurred during the experiment as well as on similar troop damage.

Such a division was already established in the partial reports, for example, for the fuselage damage. Such definite statements are not possible for the wing damage, according to our present knowledge. The damage for categories A and B was therefore summarized in the following tables.

CATEGORIES A AND B — WING DAMAGES (see also Figure 7)

| Damage No.  | Report No.             | Wing*      | Damage Location  |
|---|------------------------|------------|--|
| F16,F17,F44,<br>F24,F27,F58,<br>F65                         | 81/21                  | B          | Lower wing skin<br>countersunk hole in the<br>connection region of the<br>fittings<br>(WS 36 — 48)                 |
| RF23, RF 24,<br>RF38<br>F41,F44,F55,<br>F60,F61,F65,<br>F66 | 81/21.5<br><br>81/21.4 | R<br><br>B | Lower wing skin<br>countersunk hole in the<br>interior wing region of<br>the beam screw attachment<br>(WS 48 — 74) |
| RF 33   | 81/21.5                | R          |  |
| F19,F35,F39   | 81/21.10               | B          | Rear spar in the transition<br>region from the Double-T<br>to the U profile<br>(WS 91)                             |
| RF 31   | 81/21.7                | R          |  |
| RF13, RF14  | 81/21.7                | R          | Hinge band on the side of<br>the wing for the landing<br>flap connection   |
| F 9   | 81/21.4                | B          | Lower wing skin opening for<br>tip tank jettison arming<br>switch<br>(WS 117)                                      |
| F 59  | 81/21.4                | B          | Lower wing skin attachment<br>hole for the aileron servo   |

CATEGORIES A & B WING DAMAGES (CONTINUED)

| Damage No.                            | Report No.         | Wing* | Damage Location   |
|---------------------------------------|--------------------|-------|---|
| F20,F30,F43                           | 81/21.10           | B     | Lower wing skin,<br>milled radius in the<br>connection region of the<br>rear spar and of the landing<br>flap hinge, respectively<br>(WS 91) |
| RF27, RF34                            | 81/21.5            | R     |   |
| F2,F33,F48                            | 81/21.4            | B     | Top skin and cover at the<br>opening of the aileron<br>servo  |
| RF2, RF18                             | 81/21.5            | R     |   |
| F3,F23,F51,<br>F7,F29,F26,<br>F32,F63 | 81/21.7            | B     | Connection U profile  |
| RF3, RF17                             | 81/21.7            | R     |   |
| F37, F52,<br>F53, F54                 | 81/21.10           | B     | End rib, milled edge of<br>flange web   |
| RF25, RF30                            | 81/21.7            | R     |   |
| RF19, RF36<br>RF44                    | 81/21.7            | R     | front spar, rounding radius<br>and hinge ring on the flap<br>side   |
| RF20, RF35,<br>RF37, RF43             | 81/21.7            | R     |   |
| RF 40                                 | 81/21.7            | R     | hinges of the flaps   |
| RF29, RF32,<br>RF39                   | 81/21.5<br>81/21.7 | R     |   |
|                                       |                    |       | Beams   |
|                                       |                    |       | Aileron servo block and<br>connections with the lower<br>skin   |

\*B = basic wing; R = retrofit wing

wing structure F 104 G and TF 104 G

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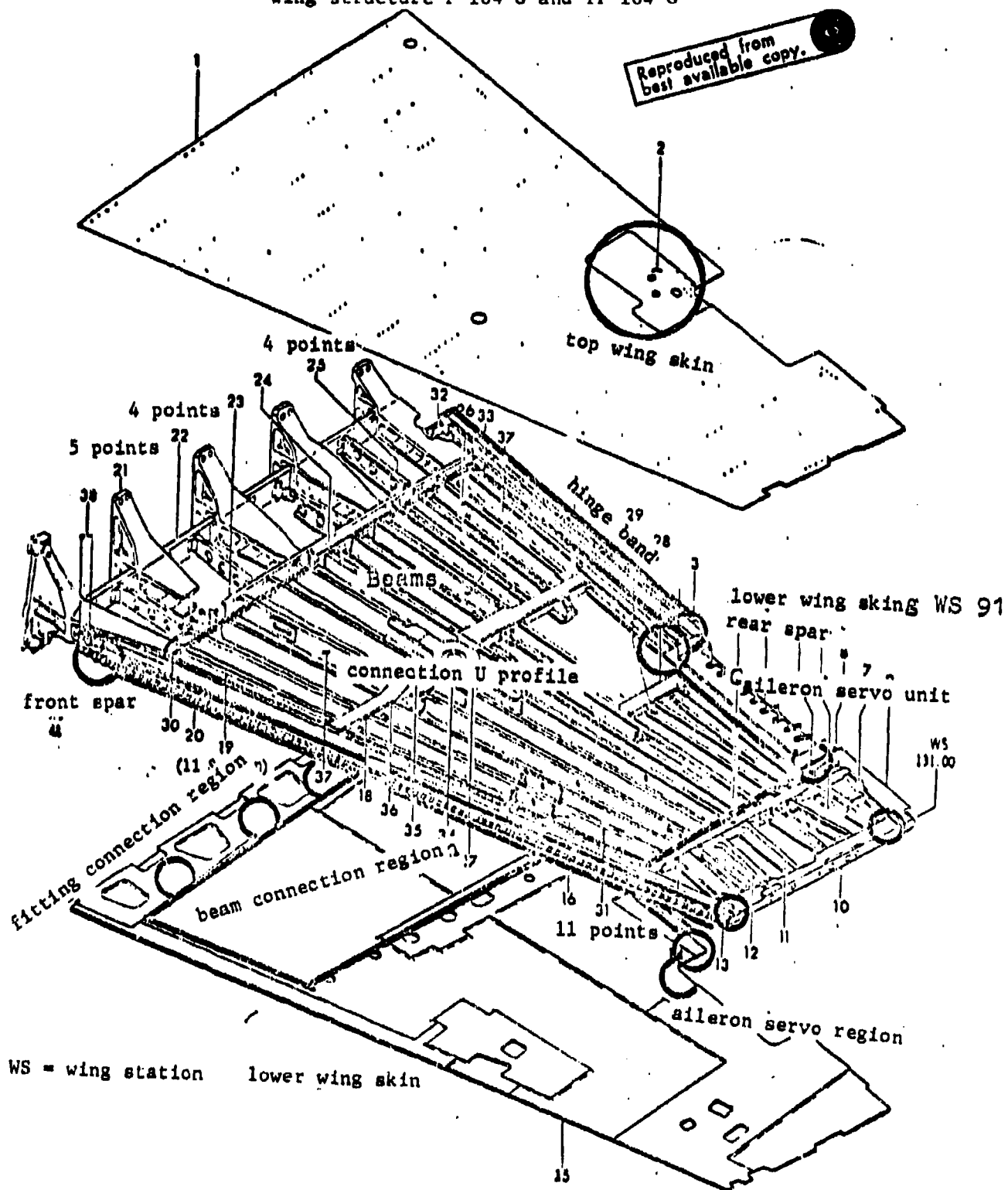


Figure 7. Wing damage summary, categories A and B.

CATEGORIES A AND B - FUSELAGE DAMAGES (see Figures 8 and 9)

| Damage Number                            | Report Number       | Damage Location   |                                |
|--|---------------------|---|--------------------------------|
| R7, R12                                  | 81/21.3             | Firewall<br>(FS 505)  |                                |
| R14, R16, R49                            | 81/21.3<br>81/21.11 | Angle Profile<br>(FS 422)   |                                |
| R 55                                     | 81/21.11            | Upper longitudinal support<br>(FS 422)  |                                |
| R2, R6, R24                              | 81/21.2             | Hydraulic flap opening<br>(FS 520)  |                                |
| R67, R77                                 | 81/21.11            | Main spar No. 5<br>Skin for main spar No. 5<br>(FS 520.5)   |                                |
| R4, R5, R8, R9,<br>R10, R11,<br>R19, R20 | 81/21.3             | Cracks along the rivets<br>of the sheet metal field<br>M13 in the span direction<br>at the upper side of the<br>air inlet channel | FS 444<br>and<br>FS440.6<br>FS |
| R21, R25,<br>R26, R27                    | 81/21.3             | Cracks at the bulge of<br>the right and left landing<br>flap actuator   | FS 527<br>and<br>FS 538        |
| R22, R40,<br>R41                         | 81/21.3             | Cracks in the sheet metal<br>field M30 at the rivets<br>with the main spar No. 5  | FS 520                         |

CATEGORIES A AND B — FUSELAGE DAMAGES (Continued)

| Damage Number                          | Report Number       | Damage Location  |                     |
|--|---------------------|--|---------------------|
| R23, R29                               | 81/21.3             | Cracks in the upper and lower radius of the ground cooling door  | FS 558 and FS546.5  |
| R28, R30, R35                          | 81/21.3             | Cracks in the sheet metal field M31 above the hydraulic flap   | FS 529 and FS 530   |
| R32, R37, R50, R53                     | 81/21.3<br>81/21.11 | Cracks in the sheet metal M5 and M6 at the rivet point   | FS399.6 and FS405.8 |
| R42, R45, R59, R60, R73, R74, R75, R76 | 81/21.3             | Cracks in the doubler below the sheet metal field M53 and in the sheet metal field M53                   | FS 493.3 to FS 514  |
| R 1                                    | 81/21.1             | Covers in the rear fuselage tank   |                     |
| R 43                                   | 81/21.3             | Cracks in the upper longitudinal support of the rear fuel container space                                | FS 438.4            |
| R58, R68, R71                          | 81/21.11            | Cracks in the reinforcement for the passage for the air removal line                                     | FS 479.5            |
| R62, R63, R64                          | 81/21.11            | Cracks in the lower longitudinal support in the landing gear channel in the left and right profile plate | FS 444              |

## CATEGORIES A AND B — FUSELAGE DAMAGES (continued)

| Damage Number   | Report Number | Damage Location  |                     |
|-----------------|---------------|--|---------------------|
| R69, R70<br>R72 | 81/21.11      | Cracks in the outer reinforcement of the basic longitudinal support for attaching the main spar Nos. 3 and 4 | FS 489.5 and FS 505 |

## Category C

Damage which occurs in regions of the total airframe fatigue experiment which is not well simulated and which, at the present time, does not appear to be critical, or for which no definite statements can be made. All the damage which does not belong to either category A or B belongs in this class.

4.4.3. Short description of the most important damage

Within the framework of the total airframe fatigue experiment F 104 G, we tested two structurally different wing types, the so-called basic wing and the retrofit wing, as well as the fuselage structure. The two wing assembly types differ most of all in the thickness of the lower skin (retrofit wing has a greater thickness in the root area), in the rear spar transition region to the aileron servo (retrofit wing is reinforced), in the fittings (retrofit with the wider flange made of AZ 74), and with respect to the surface treatment of a few components (retrofit wing is shot hardened). The basic wing, two test wings and one replacement wing in each case, were installed from the beginning of the test up to 8,687 total test hours, and the first 1000 hours were simulated according to the "Marine Aviation Wing Spectrum" (MFG test program) and the remaining test hours were simulated according to the "Tactical Combat Training Procedure (TCTP) Program." After this, the modified retrofit main wings were mounted and were tested according to the TCTP program up to 14,869 total test hours.



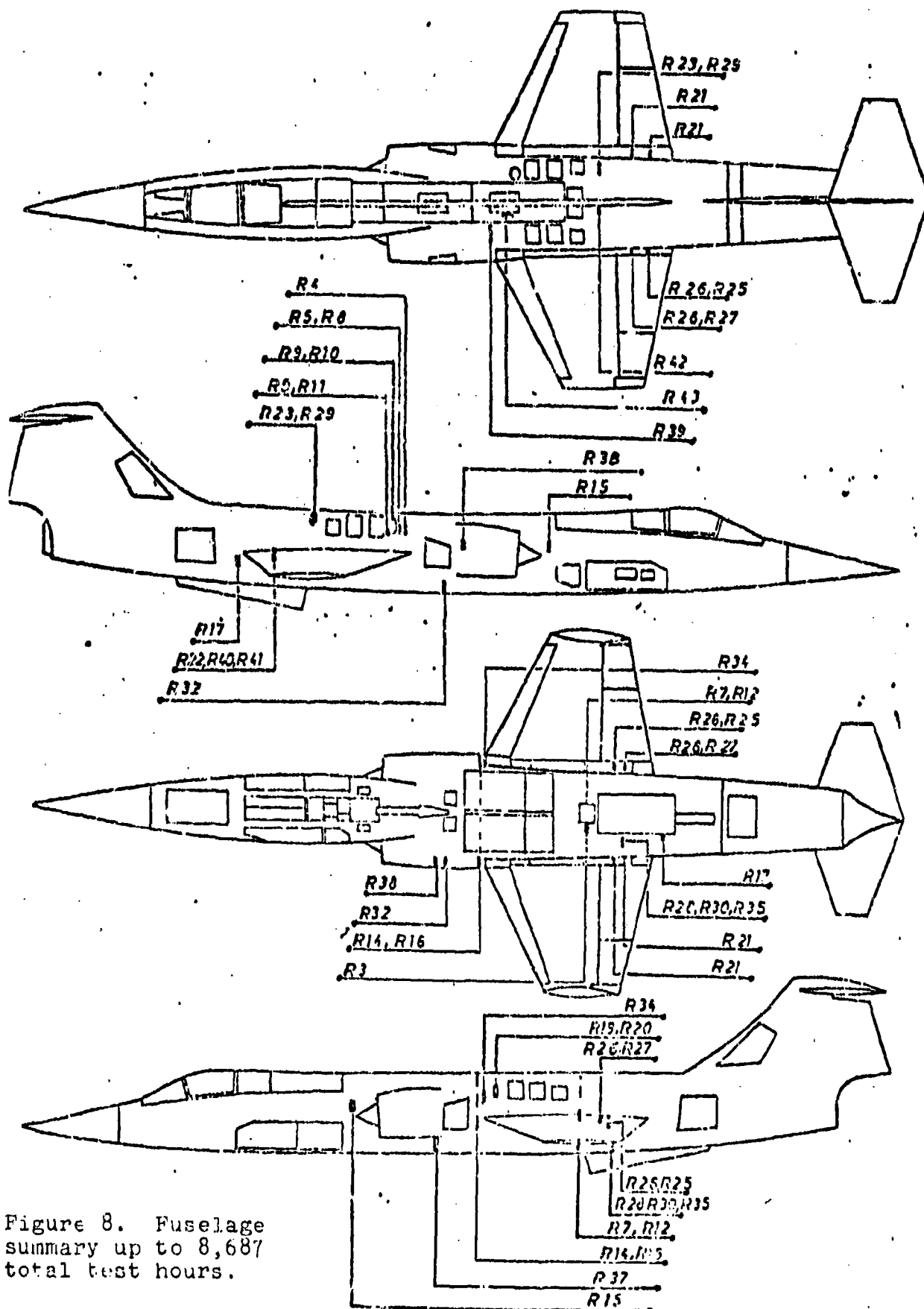


Figure 8. Fuselage summary up to 8,687 total test hours.

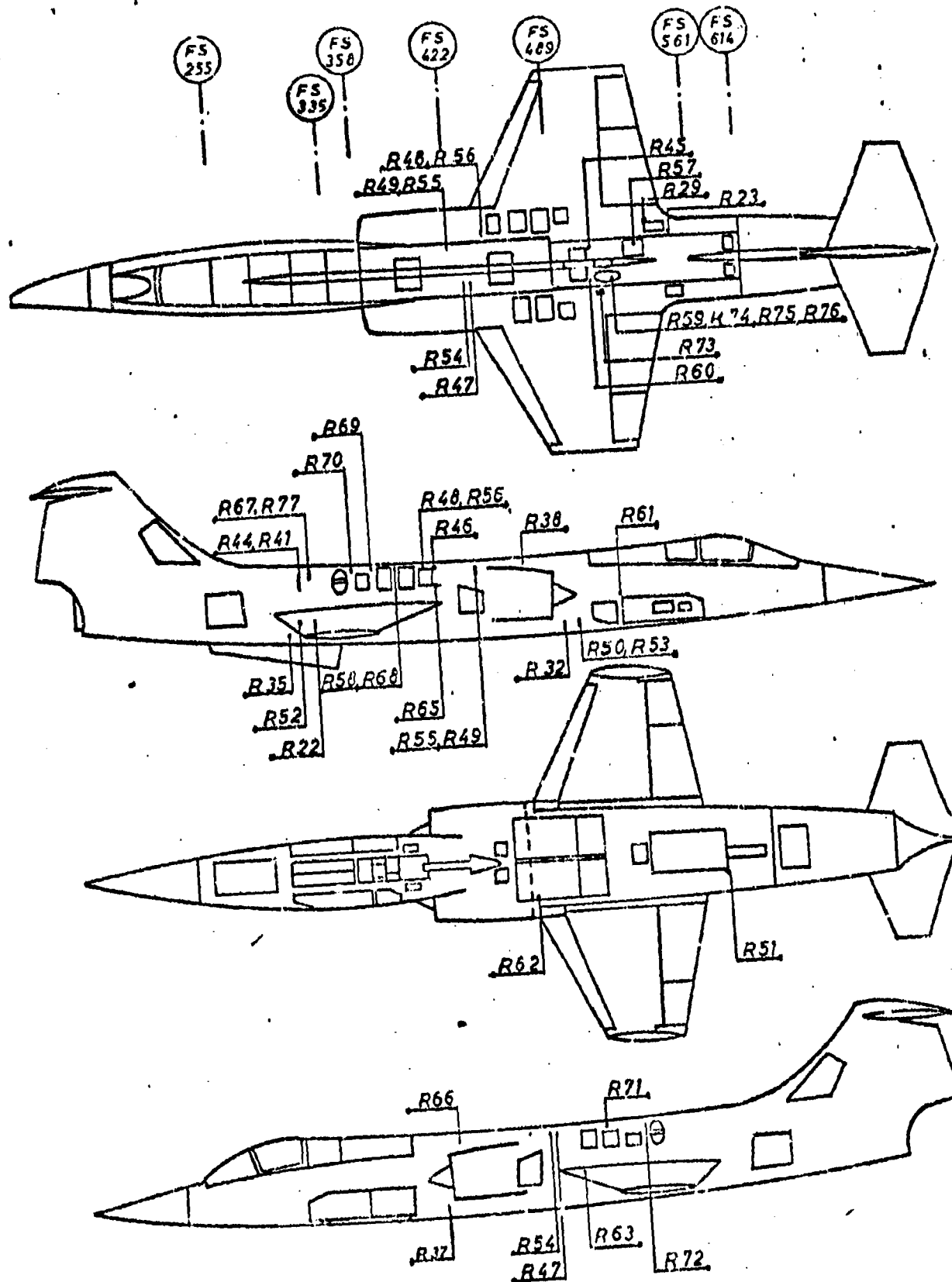


Figure 9. Fuselage damage summary between 8,687 to 14,869 total test hours.

Overall, there were a few regions which were extremely critical for fatigue in the test structure, which are given in the following in the chronological order of their appearance:

— lower wing skin WS 80.7 opening for the aileron servo in the right basic wing

The damage was first established after about a calculated 1156 TCTP component test hours and propagated along a length of 10 mm (see Figure 10) up to 1,263 TCTP component test hours. A crack at a similar position in a troop aircraft stationed in the USA led to total damage. The openings mentioned have, in the meantime, been found to be superfluous because of construction changes and all lower wing skins are now being closed in succession, or these openings are no longer made in new surfaces.

— wing connection fittings (fittings)

During the total airframe fatigue test with the basic wing, in addition to a large number of fatigue cracks, we found four total fractures in a total of 31 fittings. Of these total fractures, three occurred in fitting 5 after 1,728 2,246, and 2,280 TCTP component hours, respectively, as well as a consecutive fracture in fitting 4. The most significant cracks and fractures occurred primarily in the first hole rows on the side of the fuselage. After modifying the fittings (material change from 7079 or 7075, respectively, to AZ 74, thickening of the flange, and widening) within the framework of the retrofit program, we find a considerable improvement in the fatigue properties (see Figure 11).

— lower wing skin WS 63/67 inner pylon fitting connection

After a calculated 5,107 TCTP wing test hours, the right lower wing skin at WS 66.3 collapsed completely in the basic wing (see Figure 12). At the same time, after 4,654 TCTP component test hours, we found a crack about 35 mm long in the left basic lower wing skin in the same region at WS 63.7. The cracks in the retrofit wing

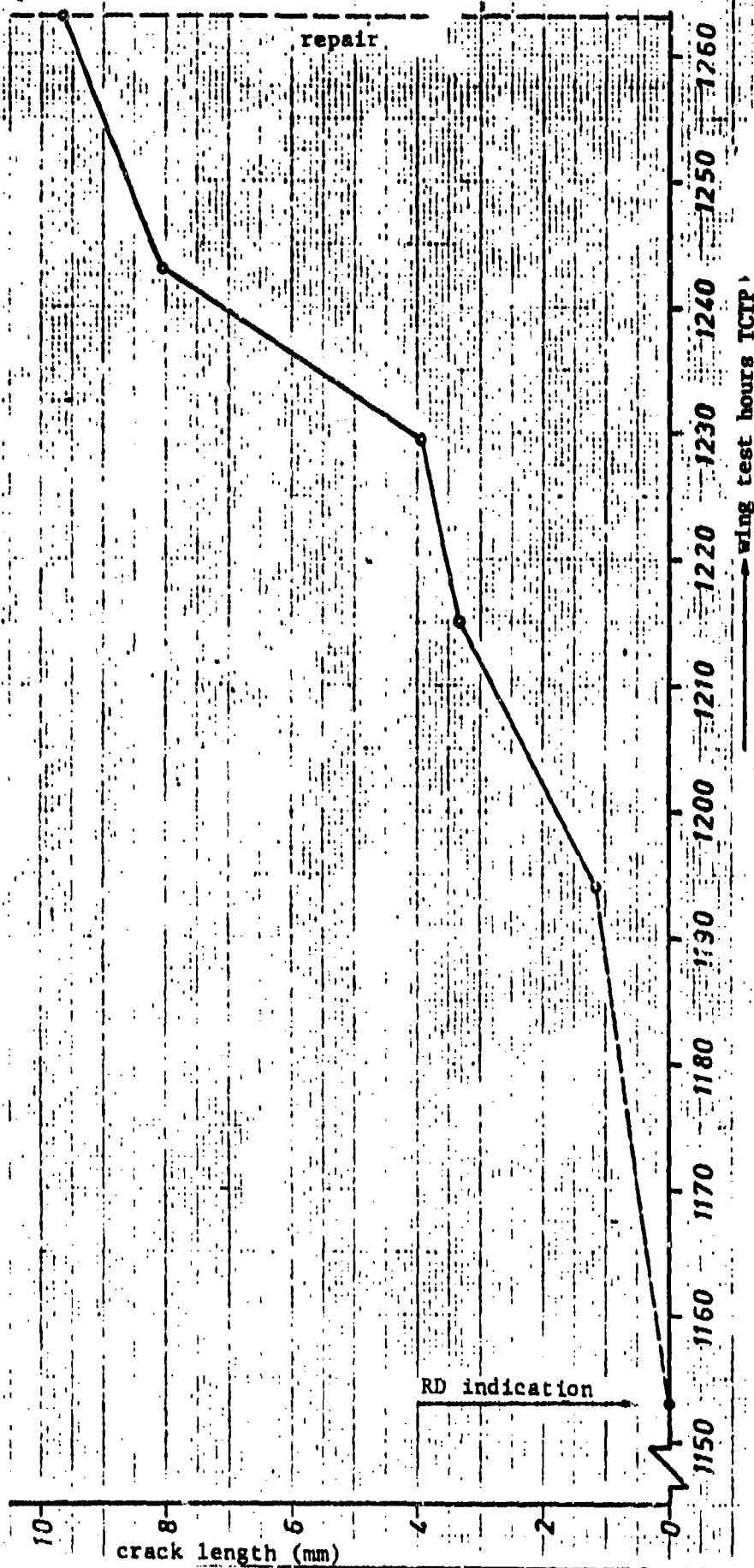


Figure 10. Crack advance variation for opening at the aileron servo. Damage No. F1 (right wing lower side, WS 80.7).

| curve number | Symbol | Fitting | hole | crack : direction (2) |
|--------------|--------|---------|------|-----------------------|
| 1            | *      | re/B    | 12   | -                     |
| 2            | o      | li/B    | 12   | -                     |
| 3            | e      | re/B    | 12   | -                     |
| 4            | +      | li/R    | 12   | iF                    |
| 5            | Δ      | li/R    | 12   | g.F.                  |
| 6            | .      | re/R    | 12   | g.F.                  |
| 7            | ▽      | re/R    | 1    | g.F.                  |
| 8            | x      | re/R    | 1    | iF                    |
| 9            | x      | re/R    | 12   | iF                    |

1) re = right 2) i.F. = in flight direction  
 li = left g.F. = against flight direction  
 basic wing (7072-T-6) No. 5  
 R = retrofit wing (AZ 74) No. 5

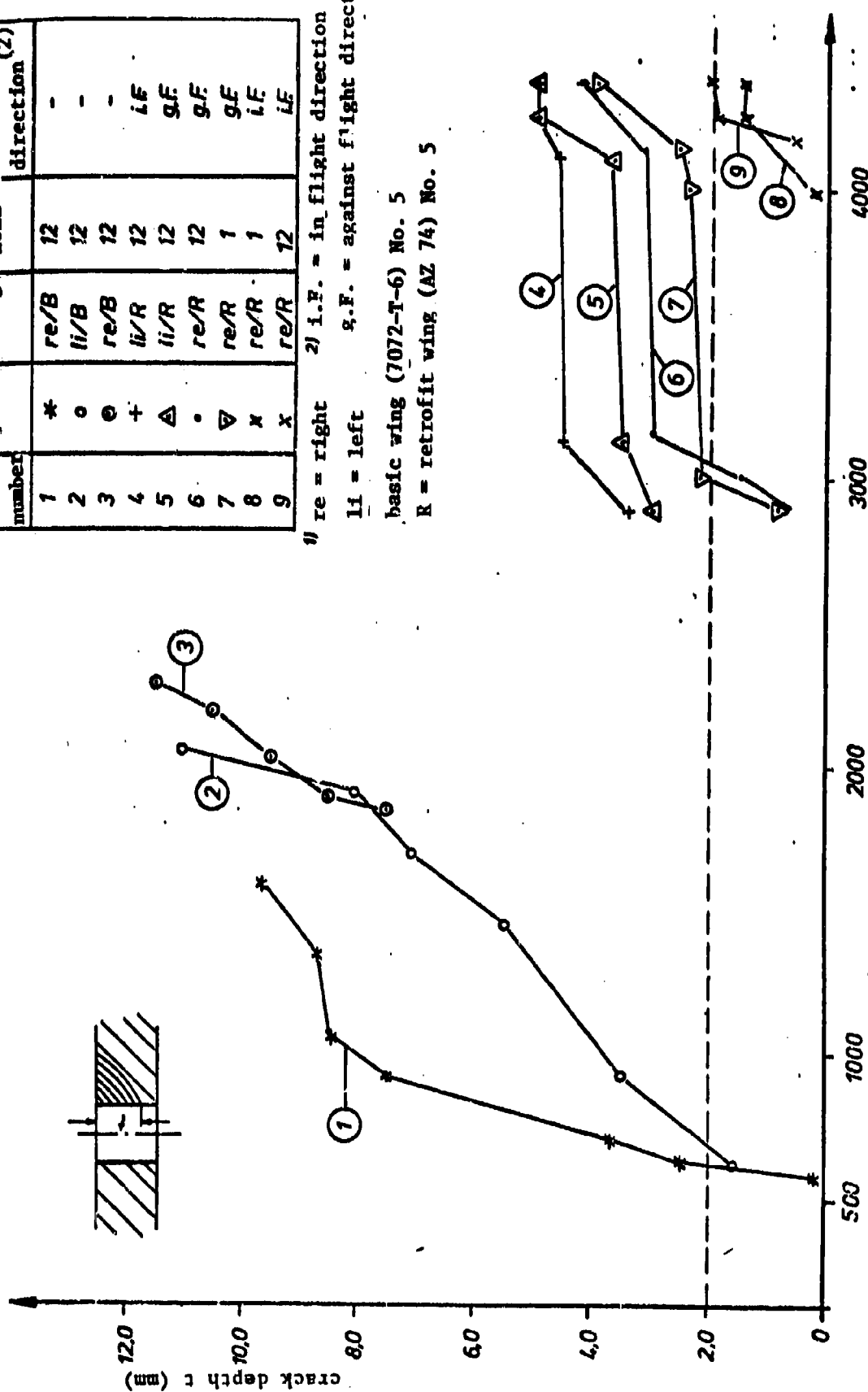


Figure 11. Crack propagation fitting No. 5 AZ 74.



Figure 12. Fracture of the lower wing skin of the right wing at WS 66.3.

propagated over a total length of 25.9 mm in the right lower skin and 2.19 mm in the left lower skin at 6,182 TCTP retrofit test hours.

Except for the surface treatment (shot hardening), the wing skins of the basic and retrofit wings are identical. In August of 1973, we found a crack about 2.0 mm long on an aircraft stationed at Luke AFB.

— lower wing skin WS 74 pylon manifold

At 4,971 TCTP wing test hours, we detected a crack with a total length of about 27 mm (see Figure 13) at the attachment hole for the fuel connection cover in the lower wing skin of the basic wing. After 4,015 TCTP wing test hours, we found cracks with a length of 0.5 to 2.5 mm in the region of the attachment holes at the left and right retrofit wings. These became enlarged up to the end of the experiment after 14,869 total test hours, corresponding to 6,182 TCTP component test hours, up to 10.3 mm. The skin thickness in this region is the same for the retrofit wing and the basic wing.

In addition to the points with extreme critical fatigue conditions mentioned above, in which the crack propagation rates partly show a strongly progressive character at a relatively early point in time and which were also partly found in troop aircraft, there are a few structural regions which can be considered to be critical for fatigue. In the following, we will discuss a representative selection of such damage:

— wing skin WS 36/48 fitting connection

The first cracks were already established in the basic wing at a relatively early point in time (about 2,200 TCTP component test hours, average crack length 1.55 mm). On the other hand, the cracks found in the retrofit wing were first found after 4,369 TCTP component hours in this region and they had a length of 0.6 mm on the average. During the concluding inspection after 6,182 TCTP component test hours, they had an average length of 1.3 mm. This tendency towards improvement can be primarily attributed to the increased skin thickness in the connection region of the fittings which was introduced.

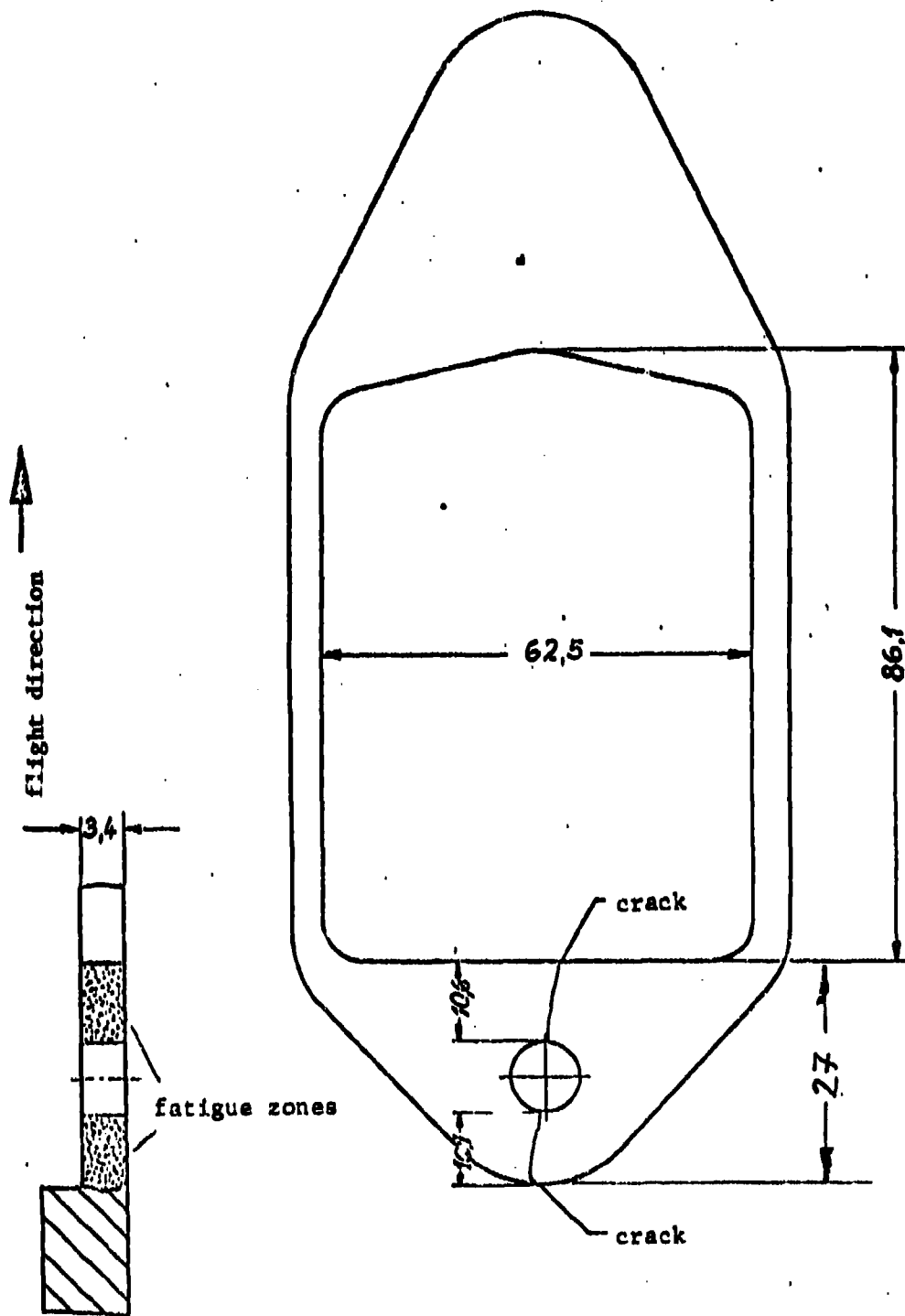


Figure 13. Small crack in the holes on the pylon manifold at WS 74 for the basic wing for 4,971 TCTP wing hours.



- lower wing skin WS 48/74 beam connection in the inner wing region

During the concluding inspections of the basic wings (right basic wing at 5,107 TCTP wing test hours, left basic wing at 6,934 TCTP wing test hours) and of the retrofit wings (right and left retrofit wings at 6,182 TCTP wing test hours), we found a number of cracks with a length of up to 6.5 mm in the countersunk holes of the beam screw connection in the lower skin.

- aileron servo block and lower skin in the region of the connection with the aileron servo block WS 92/93

After 14,869 total test hours, corresponding to 6,182 TCTP wing test hours, the lower skin of the retrofit wing assembly suddenly tore in the region of the connection with the aileron servo and the flange of the aileron servo must have been completely separated before this. Here again a comparison showed that the fatigue fracture surface only amounts to 3 — 4% of the net total fracture surface area of the lower skin.

##### 5. Summarizing Evaluation — Operational Time Intervals, Measures and Inspection Intervals

As can be seen from this short discussion of the damage in this report and from the detailed data in the partial reports, damage occurred early within the framework of the F 104 G total airframe fatigue experiment, which required special measures to be carried out, or means that these still have to be carried out for a high number of flight hours, respectively. The weak points are concentrated essentially in the wing-fuselage connection region, as well as in the region of the lower wing skin between the canted rib and the pylon rib.

In the following,        will give a brief discussion of the measures already taken or those for which a decision has already been made as far as the critical structural parts are concerned. We will make recommendations for further procedures.

### Basic Wing

— Special measures were taken early for the critical damage in the lower skin of the wing assembly in the region of the aileron servo (WS 80.7), which occurred very early during the fatigue experiment (see point 4.4.3) and which led to the loss of an aircraft at Luke.\*

— In addition to the damage mentioned above at WS 80.7, the wing connection fittings and especially fitting No. 5 must be considered as critical components. Therefore, special measures were formulated for these relatively early. The fittings were investigated for initial cracks in the critical hole 12 using a special eddy current method developed by the IABG. In these investigations, we detected initial cracks in a number of fittings before the maximum operational time interval for these components had been reached, which is fixed at 1500 flight hours (exchange within the framework of the retrofit program). Just as before, the fittings should be immediately exchanged in such cases.

— Based on the high stresses in the region of WS 47/48 which we found, as well as the fact that a fracture occurred in the Lockheed fatigue test (however, the fracture occurred after the fatigue program proper, after the load spectrum was increased), this region was first looked upon as the one most critical for fatigue. The initial cracks occurred at a relatively early point in time (about 2000 TCTP hours) during the total airframe fatigue experiment described here as well. However, they did not propagate as much as expected up to the end of the investigations with the basic wing. However,

\*[Translator's Note: Luke Air Force Base.]

since damage was found in the aircraft located at Luke and since it is not clear whether cracks are also present in the skins which were replaced at 1500 operational hours for aircraft located in Germany, we believe that the inspection procedure after TA 870 should be retained for the time being.

— After the conclusion of the investigations with the basic wing, we found that the regions WS 63/67 (inner pylon fitting connection) and the region of WS 74 (pylon manifold) were found to be the most critical for the lower skin. The total lifetime reached in the experiment was about 5,000 TCTP wing test hours. Assuming that a softer load spectrum will occur for troop operation which, on the average, will correspond to the MFG program (lifetime increase factor about 1.7 compared with TCTP) as flight measurements showed, we believe that no special measures are necessary within the framework of the retrofit program up to the specified exchange time of the lower skin.

#### Retrofit Conversion

— As is known, the wing lower skin, the wing connection fittings, the rear spar as well as obviously damaged parts are exchanged within the framework of the retrofit conversion.

— During the crack investigation within the framework of this conversion, it is especially important to investigate the end rib, the aileron servo block, the connection U profile, and the canted rib for cracks in the regions determined to be critical for fatigue during the fatigue experiment (detailed indications on these regions are contained in IABG reports TFS 81/21.6, B-TF 81/21.7, and TF 81/21.10). In addition, the pylon fittings should be included.

— In addition, the front spar should be very critically examined for initial cracks (critical region see IABG reports TF 81/21.6 and TF 81/21.7). After an exchange has taken place, one should make sure that there is an exact fit of the nose flap push bar in the region of the upper skin and of the front spar.

We were able to find wear points in the upper skin in this region on the left converted retrofit wings during the total airframe fatigue experiment. Apparently these contributed to the 80 mm crack in the flange of the front spar. Similar damage occurred in Italy, according to data by the firm Fiat.

— Within the framework of the retrofit conversion for the test airframe, we established a large number of small initial cracks in the sheet spars (beams). As already surmised in Report TFS 81/21.6, this damage, which was partially left in the retrofit surfaces, was not found to be especially critical in the subsequent fatigue experiment. However, it is recommended to visually inspect (with a magnifying glass) these regions for initial cracks and to exchange damaged beams. It is assumed that cracks with a length above 2 mm can be detected with certainty.

#### Retrofit Wing

— Based on the results with the retrofit version, in conclusion we may say that the fatigue properties of the fittings are considerably better than the fittings of the basic version. The main effect is probably due to the increased material thickness, i.e., the reduction of the stress level in the critical region. In addition, the critical crack length or the fatigue surface at the time of fracture, respectively, is considerably more favorable, i.e., it is greater than for the fittings made of AZ 74 (see also IABG reports TF 81/21.9 and TF 248/1) than for the basic version.

— The critical fitting No. 5 was exchanged during the fatigue experiment at 4,369 TCTP test hours with even more damage. The participating entities (essentially the MBB-UF and IABG) carried out statistical investigations based on the experimental results including the scatter and risk factors. These had the purpose of determining a realistic minimum lifetime for an acceptable failure probability. During a discussion between BWB-ML, LBF, MBB-UF, and the IABG, we established that an expected operational time period of 2300 MFG flight hours (recently called the unit program) would be acceptable. However, it is assumed that fitting No. 5 will be inspected at the

critical hole No. 2 using the eddy current crack test according to TA 979 after 1800 flight hours, which have been used previously in the basic wing. Based on the more favorable behavior of the retrofit fittings, as far as crack propagation is concerned, we believe that the inspection interval can be increased from 50 flight hours, as was the case up to the present, to 100 flight hours, for the retrofit wing.

— In the discussion given above, we agreed that the expected operational time period for the wing lower skin was also 2300 unit program flight hours. This was concluded on the basis of available test results. From our present day knowledge, we believe that no additional inspections are necessary for the skin up to this time. The given lifetime of 2300 flight hours could be increased according to our present knowledge, if special inspections, essentially concerned with the lower skin in the region of the pylon fitting and the pylon manifold, could be carried out separately. These inspections are somewhat problematical, however, because the pylon manifold is not freely accessible. Also, as the fatigue experiment shows, there is in part a very strong crack progression, so that short inspection intervals (a maximum of 50 hours) would be necessary.

— The lower wing skin in the region of WS 36/48, which was already found not to be as critical as originally assumed in the basic wing, is even less critical for the retrofit wing, because of the thicker skin in this region. Special measures are not necessary for the retrofit wing in this region.

— In addition to the measures given above, all remaining damage (see point 4.4.2) classified under A and B must be carefully inspected during change maintenance procedures of the retrofit wing.

#### Fuselage Structure

— No serious damage was found in the fuselage structure during the F 104 G total airframe fatigue test. In other words, no special measures are required up to the end of operations using the second pair of wings (retrofit). However, it is assumed that regions

classified in this report under classifications A and B will be carefully inspected within the framework of change maintenance procedures, and that possible damage will be rectified, because much of the fuselage damage considered critical can lead to secondary effects, stress redistributions, etc., and, therefore, overloads of supporting members, if the fuselage damage increases. The upper longitudinal supports must be inspected with special care.

— One may consider the use of a third pair of wings after specifying special measures. Special inspections for the upper longitudinal supports and for the main rib are required. From our present knowledge, we believe that at least the wing-fuselage connection ribs No. 3 to No. 5 should be routinely x-rayed in the critical region of the rib-spar rivet connection (see partial report TF 81/21.11). Since no data is available on the crack propagation, and since we expect a strong progression of the crack propagation, the inspection intervals should not exceed 50 operational hours.

— For the data on the operational time interval of the fuselage, one must consider the fact that only the central region was loaded and tested in a representative way during the fatigue experiment. Damage which could occur in the region of the nose and front part of the fuselage and, especially in the inlet tracks, is not covered by this. An especially careful inspection within the framework of the change maintenance procedure must be made for these regions, if the fuselage structure is used for the second or even the third pair of wings.

## APPENDIX A

TABLE A1. Total Fuselage Fatigue Tests F 104 G  
List of Reports

Page

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TABLE A1  
TOTAL FUSELAGE FATIGUE TESTS F 104 G  
List of Reports

| Titel<br>Title  | Datum<br>Date | Bericht Nr.<br>Report No. |
|---|---------------|---------------------------|
| Einfluß von Klappenausschlägen auf die Spannungsverteilung an Flügel der F 104 G<br>Influence of Flap Deflections on Stress Distribution on F 104 G Wing Root | 16.06.67      | 81/01                     |
| Einfluß von Klappenausschlägen auf die Spannungsverteilung an Flügel der F 104 G<br>Influence of Flap Deflections on Stress Distribution of F 104 G Wing Root | 1.07.70       | 81/32                     |
| Lebensdauerverbesserung durch Coenen<br>Fatigue Improvement by Coening Method   | 15.01.74      | 81/63                     |
| Flügel-Lastableitung<br>Load Introduction to Wing Structure   | 22.09.72      | 81/04                     |



TABLE A1

| Titel   | Datum    | Bericht Nr. |
|---|----------|-------------|
| Title   | Date     | Report No.  |
| Einstufenversuch an einem gebogenen Probestab zur Erprobung eines Ribartenungsverfahrens mit Dehnstreifen | 23.10.69 | 81/05       |
| Constant Amplitude Fatigue Test on a Notched Specimen for Examining a Crack Detection Method              |          |             |
| Spannungsanalyse - Klappenausschläge  | 20.11.73 | 81/06       |
| Stress Analysis for Flap Deflections on F 104 G Wing  |          |             |
| Einfluß von Querruvorausschlägen auf die Spannungsverteilung am Flügel der F 104 G                        | 9.05.69  | 81/07       |
| Influence of Aileron Deflections on Stress Distribution of F 104 G Wing                                   |          |             |
| Anordnung der Dehnstreifen, Teil A und B  | 12.03.74 | 81/08       |
| Position of the Straingages, Part A and B   |          |             |
| Versuchslasten, Teil A, B und C   | 8.02.74  | 81/09       |
| Test-Loads, Part A, B and C   |          |             |
| Belastungsprogramm  | 28.02.74 | 81/10       |
| Loading Program   |          |             |
| Spannungsanalyse F 104 G, Flügel rechts, Teil A   | 1.04.70  | 81/11       |
| Stress Analysis F 104 G Wing right, Part A  |          |             |

TABLE A1  
(Continued)

| Title  | Datum    | Bericht Nr.<br>Date Report No. |
|--|----------|--------------------------------|
| Spannungsanalyse F 104 S, Flügel links und Recht, Teil B<br>Stress Analysis F 104 S Wing Left and Fuselage, Part B | 1.04.70  | 85/11                          |
| Spannungsanalyse - Retrofitflügel<br>Stress Analysis - Retrofitwing  | 12.01.74 | 81/12                          |
| Minerrechnung<br>Fatigue Damage Calculation  | 29.10.71 | 81/14                          |
| Fitting - Probestabversuche<br>Fitting - Specimen Test   | 1.12.72  | 81/16                          |
| Gesamtzellen- Ermüdungsversuch - Versuchsaufbau<br>Full Scale Fatigue Test Set-Up                                  | 24.03.73 | 81/18                          |
| Abschlussbericht<br>Final Report   | 15.03.74 | 81/20                          |
| Risse im hinteren Tankdeckel<br>Fatigue Cracks in the Rear Fuel Tank Cover   | 10.12.73 | 81/21.1                        |

TABLE A1  
(Continued)

| Title   | Date     | Report No. |
|---|----------|------------|
| Risse an Ausschnitt der Hydraulikkappenöffnung<br>Fatigue Cracks in the Corners of the Hydraulic Access Door        | 7.10.71  | 81/21.2    |
| Schäden an der Rumpfstruktur<br>Fatigue Cracks in the Fuselage  | 13.07.72 | 81/21.3    |
| Schäden an der Flügelbepankung<br>Fatigue Damages in the Wing Skin  | 5.04.73  | 81/21.4    |
| Bepankungsschäden - Retrofit<br>Fatigue Damages in the Skin of the Retrofit-Wing                                    | 22.02.74 | 81/21.5    |
| Schäden an den Flügelinnenteilen<br>Fatigue Cracks in the Inner Parts of the Wing (Beams, Ribs)                     | 5.05.72  | 81/21.6    |
| Schäden an den Flügelinnenteilen - Retrofit<br>Fatigue Cracks in the Inner Parts of the Retrofit-Wing (Beams, Ribs) | 28.03.74 | 81/21.7    |
| Schäden an den Flügel-Rumpfanschließungen<br>Fatigue Failures and Cracks in the Wing Attachment Fittings            | 1.07.72  | 81/21.8    |

TABLE A1  
(Continued)

| Titel<br>Title  | Datum<br>Date | Bericht Nr.<br>Report No. |
|---|---------------|---------------------------|
|   |               |                           |
| Fittingschäden an Retrofitflügel<br>Fatigue Failures and Cracks in the Retrofit-Wing Attachment Fittings  | 20.01.74      | 81/21.9                   |
| Risse in Hinterholz und Endrippe<br>Fatigue Cracks in the Rear Beam and the Tip Rib   | 9.05.73       | 81/21.10                  |
| Rumpfsschäden zwischen 8687 und 14869 Gesamtteststunden<br>Fatigue Cracks in the Fuselage between 8687 and 14869 Total Test Hours                                 | 14.03.74      | 81/21.11                  |
| Wirbelstrom - R3prüfverfahren I für Tragflügel F 104, Fitting 5, Bolthale 12<br>Eddy-Current Crack Inspection for the Wing of the F 104 6, Fitting 5, Bolthale 12 | 19.11.70      | 81/72                     |

## APPENDIX B

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TABLE B1. DAMAGE TO BASIC WINGS

| Damage no. | Section or component part no.                  | Description of damage location   | Wing station WS | Damage  |                        | Determined after number of test hours | TCTP completion hours | Explanation, see IABG report no. | Remarks and measures taken  | Classification |
|------------|--|--|-----------------|---------|------------------------|---------------------------------------|-----------------------|----------------------------------|---|----------------|
|            |  |  |                 | Type 1) | Size Direction 2) (mm) |                                       |                       |                                  |   |                |
| F1         | right wing<br>7210 lower wing skin<br>783194-2 | opening for the aileron servo, rear radius                               | 80.7            | R       | g.f.                   | < 1.0                                 | 1156                  | 81/21.4                          | similar to damage F 31  | I              |
|            |  |  |                 | RV      |                        | < 1.0                                 | 1604                  | Kap.3.1.5.1                      |   |                |
|            |  |  |                 | RV      |                        | 4.0                                   | 1625                  | -                                |   |                |
|            |  |  |                 | RV      |                        | 4.0                                   | 1639                  |                                  | repair according to IABG drwg. No. 2135-249.00C                           |                |
|            |  |  |                 | RV      |                        | 9.0                                   | 1653                  |                                  |   |                |
|            |  |  |                 | RV      |                        | 9.3                                   | 1673                  |                                  |   |                |
| F2         | right wing<br>710 upper wing skin<br>783193-2  | radius at the trailing edge of the opening for the aileron servo beam 14 | 89.0            | R       | g.f.                   | 1.5                                   | 1673                  | 81/21.4                          | repair by re-inforcing with T profile according to drwg. No. 2135-250.00C | A              |
|            |  |  |                 |         |                        | 10.0                                  | 1673                  | Kap.3.2.1.1<br>Kap.3.2.1.2       |   |                |
| F3         | right wing<br>7210 bent U profile<br>783217-8  | connection U profile, beam 14 /aileron block, radius at upper web flange | 88.7            | MR      |                        | max. 22.4                             | 1673                  | 81/21.7                          | similar to damage F7, F23, F29, F51                                       | A              |
|            |  |  |                 | R       |                        | 22.4                                  | 1673                  | Kap.4.1.1                        | exchange for a new part   |                |

1) k = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards

i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.             | Description of damage location                                     | Wing station WS | Damage                   |                      | Determined after number of test hours | TCTP component hours                 | Explanation, see IABG report no. | Remarks and measures taken   | CLASSIFICATION |
|------------|---|--|-----------------|--------------------------|----------------------|---------------------------------------|--------------------------------------|----------------------------------|--|----------------|
|            |   |  |                 | Type 1)                  | Direction 2)         |                                       |                                      |                                  |  |                |
| F4         | right wing 7210, beam 14, 783217-6        | attachment holes for rubbing block                                 | 76.7 - 88.5     | MR                       |                      | max. 4.0                              | 1263                                 |                                  | beam was reinforced according to IABG Drwg. No. 2135-250.00R                                   | C              |
| F5         | left wing 7210 lower wing 783 194-1       | opening for tip tank jettison arming switch. crack at rear radius. | 117.1           | R<br>RV<br>RV            | g.F.<br>g.F.<br>g.F. | 7.5<br>15.0<br>15.0                   | 1344<br>1720<br>6934                 | 81/21.4<br>Kap. 3.1.6.2          | comparable damage F9   | L              |
| F6         | right wing 7210 lower wing skin 783 194-2 | Jo-Bolt hole 12, beam 11   | 66.0            | R<br>RV<br>R<br>RV<br>RV | i.S.<br>i.S.         | 5.0<br>5.0<br>10.0<br>13.0<br>13.0    | 1406<br>5107<br>1406<br>1598<br>5107 | 81/21.4<br>Kap. 3.1.3.1          | apparently caused by introduction of force, therefore, not representative                      | C              |
| F7         | right wing 7210, bent J profile 783 217 2 | crack in the radius at upper web flange                            | 88.7            | R                        |                      | 5.5                                   | 1723                                 | 81/21.1<br>Kap. 4.3.1            | exchange for a modified new part (without penetration according to IABG Drwg. No. 2135-253.00D | A              |

Kap = chapter  
ABB = figure

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.                  | Description of damage location  | Wing station WS | Damage  |              | Determined after number of test hours | TCIP component hours | Explanation, see IABC report no. | Remarks and measures taken  | USCIB |
|------------|--|---|-----------------|---------|--------------|---------------------------------------|----------------------|----------------------------------|---|-------|
|            |  |   |                 | Type 1) | Direction 2) | Size (mm)                             |                      |                                  |   |       |
| F7         |  |   |                 |         |              |                                       |                      |                                  | similar to damage F3, F23, F29, F51.  |       |
| F8         | right wing 7210 lower wing skin 783194-2       | crack in the depressed hole of the line of screws. Rib WS 94              | 93,5            | R       | i.f.         | 0,5                                   | 2074                 | 1664                             | no continuation determined  | C     |
| F9         | left wing 7210 lower wing skin 783194-1        | opening for tip tank jettison arming switch                               | 117,5           | R       | i.s.         | 12,8<br>12,8                          | 2138<br>8687         | 1728<br>6934                     | similar to damage F5  | A     |
| F10        | left wing 7210, fitting 5, 783199-1            | fracture on the fuselage side first and second row of holes, lower flange | 35 -<br>36      | B       |              |                                       | 2138                 | 1728                             | exchange against new part similar to damages F10, F13, F14, F15, F22, F28, F42, F46, F67, F68 |       |
| F11        | right wing 7210 landing flap actuator D 1228-2 | lower flange  | -               | B       |              |                                       | 2138                 | 1728                             | no evaluation value because it is an old repaired part  | C     |

1) R = crack  
B = fracture  
RV = crack extension

2) O = upwards  
u = downwards  
MR = several cracks  
i.f. = in flight direction  
g.f. = against flight direction

i = inwards  
a = outwards  
i.s. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure



TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.               | Description of damage location                                 | Wing station WS | Damage  |                   | Determined after number of test hours | TCTP component hours | Explanation, see IABG report no. | Remarks and measures taken   | Classification |
|------------|---|--|-----------------|---------|-------------------|---------------------------------------|----------------------|----------------------------------|--|----------------|
|            |   |  |                 | Type 1) | Direction 2) (mm) |                                       |                      |                                  |  |                |
| F12        | right wing<br>7210, fitting<br>5, 783 199-2 | fracture in the fuselage side first row of holes, lower flange | 35              | B       |                   | 2656                                  | 2246                 | 81/21.8<br>Kap.3.5.2.1           | exchanged for new part. Similar to damage F12, F10, F13, F14, F15, F22, F28, F42, F46, F67, F68                  | X              |
| F13        | right wing<br>7210, fitting<br>4, 783 198-2 | fracture in the hole row on the fuselage side, lower flange    | 35              | B       |                   | 2656                                  | 2246                 | 81/21.8<br>Kap.3.4.2.1           | Secondary fracture because of F12, exchanged. Similar to damage F10, F12, F15, F14, F22, F28, F42, F46, F67, F68 | X              |
| F14        | right wing<br>7210, fitting<br>3, 783 158-2 | cracks in upper and lower chord                                | 36 -<br>48      | R       | < 1.0             | 2656                                  | 2246                 | 81/21.8<br>Kap.3.3.2.1           | exchanged for new part. Similar to damage F10, F12, F13, F15, F22, F28, F42, F46, F67, F68                       | X              |

1) R = crack  
B = fracture  
RV = crack extension

2) O = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
AB3 = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Section or component part no.                        | Description of damage location  | Wing station WS  | Damage  |  | Determined after number of test hours  | TCTP component hours   | Explanation, see IABG report no.   | Remarks and measures taken  | Classification |
|--|---|--|---|--|--|--|--|---|----------------|
|  |   |  | Type 1)   | Direction 2)   |  |  |  |   |                |
| FL5 right wing 7210 fitting 2, 783 196-2             | cracks in upper and lower chord   | 36 - 42  | E   |  | 2656   | 7246   | 81/21.3 Kap.3.2.2.1  | exchange for new part, similar to damage F10, F12, F13, F14, F22, F28, F42, F46, F57, F68 | I              |
| FL6 right wing 7210 lower wing skin 782 194-2        | cracks in the countersunk holes skin-fitting-connection-holes 7, 14, 15, 23, and 30 Hole 7 Hole 14 Hole 15 Hole 23      | 44 - 47  | R<br>RV<br>R<br>R<br>R<br>RV<br>RV<br>RV<br>RV<br>R<br>RV<br>RV<br>RV<br>RV<br>RV<br>RV | i.f.<br>and<br>g.f.<br>g.f.<br>i.f.<br>i.f.<br>and<br>g.f.<br>i.f.<br>and<br>g.f.<br>i.f.<br>and<br>g.f.<br>i.f.<br>and<br>g.f.<br>i.f.<br>and<br>g.f. | 0.5<br>max.:<br>1.5<br>0.5<br>0.5<br>0.5<br>0.5<br>1.5<br>2.0<br>5.0<br>5.0<br>0.5<br>1.5<br>2.0<br>4.0<br>5.0<br>4.0<br>5.0 | 2656<br>6407<br>2656<br>6407<br>2656<br>2740<br>3981<br>4246<br>6407<br>2656<br>2740<br>3981<br>4246<br>4246<br>6407<br>6407 | 2246<br>5107<br>2246<br>5107<br>2246<br>2330<br>3571<br>3836<br>5107<br>2246<br>2330<br>3571<br>3836<br>3836<br>5107<br>5107 | 81/21.4 Kap.3.1.1.1 similar to damage F17, F44, F24, F65                                  | A              |
| 1) R = crack<br>B = fracture<br>RV = crack extension | 2) o = upwards<br>u = downwards<br>MR = several cracks<br>i.f. = in flight direction<br>g.f. = against flight direction | i = inwards<br>a = outwards<br>i.S. = in span direction<br>R.M. = to fuselage center |   | Kap = chapter<br>ABB = figure  |  |  |  |   |                |

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.             | Description of damage location  | Wing station WS | Damage  |                   | Determined after number of test hours | TCTP component hours | Explanation, see IABG report no. | Remarks and measures taken                    | CLASSIFICATION |
|------------|---|---|-----------------|---------|-------------------|---------------------------------------|----------------------|----------------------------------|---|----------------|
|            |   |   |                 | Type 1) | Direction 2) (mm) |                                       |                      |                                  |   |                |
| F17        | right wing 7210 lower wing skin 783 194-2 | fitting-skin-connection and region of canted rib  | 47/48           | R       | i.F./g.f.         | 2656                                  | 2246                 | 8/21.4 Kap.2.1.1.1               | crack propagation of F16                      | A              |
| F18        | right wing 7210 intercostal 760 484       | intercostal No. 4 first Huck bolt hole on fitting No. 5 of the lower wing skin connection | 36              | R       | 38,5              | 2656                                  | 2246                 | --                               | exchange crack in shape of a spider           | C              |
| F19        | right wing 7210 rear spar 783 194-2       | rounding radius. web -- lower flange  | 88.9            | R       | RM                | 2656                                  | 2246                 | 8/21.40 Kap.2.3                  | repair. Similar to damage F35, F39, F43, F62. | A              |
| F20        | right wing 7210 lower wing skin 783 194-2 | radius of milling for the landing flap hinge  | 91              | R RV    | RM 22,5 36,0      | 2656 6407                             | 2246 5107            | 8/21.40 Kap.2.1                  | similar to damage F30, F43                    | A              |
| F21        | left wing 7210 end rib                    | rivet mother disc for position lamp attachment  | 131             | R       | 2,0               | 2656                                  | 2246                 | 8/21.40 Kap.3.1                  | similar to damage F36. Exchange               | C              |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no. | Description of damage location     | Wing station WS | Damage  |              | Determined after number of test hours | TCTP component hours                    | Explanation, see ABC report no. | Remarks and measures taken   | Classification |
|------------|-------------------------------|------------------------------------|-----------------|---------|--------------|---------------------------------------|---|---------------------------------|--|----------------|
|            |                               |                                    |                 | Type 1) | Direction 2) |                                       |   |                                 |  |                |
| F22        | left wing                     | cracks in wind                     | 34 + 47         | R       | i.F./g.F.    |                                       |   | 81/21.8                         | Exchange of fittings 2 — 5. Similar to damage F10, F12, F13, F14, F15, F28, F42, F46, F67, F68 | X              |
|            | 7210 fittings                 | connection holes                   |                 |         |              |                                       |   |                                 |  |                |
|            | 783 196-1                     | Fitting No. 2                      |                 |         |              |                                       |   |                                 |  |                |
|            | 783 197-1                     | Fitting No. 3                      |                 |         |              |                                       |   |                                 |  |                |
|            | 783 198-1                     | Fitting No. 4                      |                 |         |              |                                       |   |                                 |  |                |
| F23        | left wing                     | radius at the                      | 88.7            | R       | 15           | 3000                                  | 1927                                    | 81/21.7<br>Kap. 4.1             | similar to damage F3, F7, F29, F51   | A              |
|            | 7210 bent                     | upper web flange                   |                 |         |              |                                       |   |                                 |  |                |
|            | U profile                     |                                    |                 |         |              |                                       |   |                                 |  |                |
|            | 783 217-7                     |                                    |                 |         |              |                                       |   |                                 |  |                |
|            |                               |                                    |                 |         |              |                                       |   |                                 |  |                |
| F24        | left wing                     | countersunk holes                  | 44 + 47         | R       | i.F./g.F.    | 3000                                  | 2590<br>6934                            | 81/21.4<br>Kap. 3.1.1.2         | similar to damage F16, F17, F44, F65   | A              |
|            | 7210 lower                    | of skin, fitting                   |                 |         |              |                                       |   |                                 |  |                |
|            | wing skin                     | connection bolts,                  |                 |         |              |                                       |   |                                 |  |                |
|            | 783 194-1                     | fitting No. 3,                     |                 |         |              |                                       |   |                                 |  |                |
|            |                               | region, holes 6, 7, 15, 23, 24, 30 |                 |         |              |                                       |   |                                 |  |                |
| F25        | left wing                     | Fitting No. 2                      | 37 + 47         | R       | i.F./g.F.    | 4000                                  | 1000<br>unknown<br>operational<br>hours | -                               | exchange evaluation of damage not possible   |                |
|            | 2003 fittings                 | Fitting No. 3                      |                 |         |              |                                       |   |                                 |  |                |
|            | 783 196-1                     | Fitting No. 4                      |                 |         |              |                                       |   |                                 |  |                |
|            | 783 197-1                     | Fitting No. 5                      |                 |         |              |                                       |   |                                 |  |                |
|            | 783 198-1                     |                                    |                 |         |              |                                       |   |                                 |  |                |

- 1) R = crack  
B = fracture  
RV = crack extension
- 2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction
- i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center
- Kap = chapter  
ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.  | Description of damage location  | Wing station WS | Damage  |   | Determined after number of test hours | TCIP component hours                 | Explanation, see IABG report no.                         | Remarks and measures taken  | Classification |
|------------|--|---|-----------------|---------|---|---------------------------------------|--------------------------------------|--|---|----------------|
|            |  |   |                 | Type 1) | Direction 2) (mm)   |                                       |                                      |  |   |                |
| F26        | left wing<br>2003 bent<br>U profile<br>783 217-1   | radius at the upper web flange  | 88,7            | R       | 12  | 4000                                  | 1000 + unknown operational hours     | 81/21.7 Kap. 4.1   | Exchange similar to damage F32, F63   | A              |
| F27        | right wing<br>7210 lower wing skin<br>783 194-2  | beginning cracks in the counter-sunk holes of the skin fitting connection.<br>Holes 7, 14, 15, 23 | 44 + 47         | RV      | if/gf max. 4,5  | 4246                                  | 3836                                 | -  | crack extension of damage R16   | A              |
| F28        | right wing<br>7210 fittings<br>763 195-2<br>783 196-2<br>783 197-2<br>783 198-2<br>783 199-2 | Fitting No. 1<br>Fitting No. 2<br>Fitting No. 3<br>Fitting No. 4<br>Fitting No. 5                 | 36 + 47         | R       | if/gf<br>0,3+0,6<br><0,5<br>0,2+2,0<br>0,2+4,0<br>0,2+2,5 | 4246<br>4246<br>4246<br>4246<br>4246  | 3836<br>1590<br>1590<br>1590<br>1590 | 81/21.8<br>ABB 4<br>ABB 10<br>ABB 17<br>ACR 25<br>ABB 37 | similar to damage F10, F12, F13, F14, F15, F22, F42, F46, F67, F68<br>Fittings 2 exchanged for new version. | X              |
| F29        | right wing<br>7210 bent U profile<br>783 217-2   | radius at the upper web flange  | 88,7            | R       | 9,0   | 4246                                  | 2108                                 | 81/21.7 Kap. 4.1   | Similar to damage F3, F7, F23, F51 exchange   | A              |

1) R = crack  
B = fracture  
KV = crack extension

2) o = upwards  
u = downwards  
NR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.             | Description of damage location               | Wing station WS | Damage              |              | Determined after number of test hours | TCIP component hours  | Explanation, see IABG report no. | Remarks and measures taken           | Classification |
|------------|---|--|-----------------|---------------------|--------------|---------------------------------------|---|----------------------------------|--------------------------------------|----------------|
|            |   |  |                 | Type 1)             | Direction 2) |                                       |   |                                  |                                      |                |
| F30        | left wing 7210 lower wing skin 783 194-2  | radius of milling for the landing flap hinge | 91              | R<br>RV             | RR           | 32,0<br>35,0                          | 3611<br>6934  | 81/21.10<br>Kap. 2               | similar to damage F20, F43           | A              |
| F31        | right wing 7020 lower wing skin 783 194-2 | opening for the aileron servo rear radius    | 80,7            | R<br>RV<br>RV<br>RV |              | 0,4<br>3,6<br>6,0<br>7,4              | 637<br>854<br>887<br>890<br>additionally 1342 troop operational hours | 81/21.4<br>Appendix A            | similar to damage F1                 | X              |
| F32        | right wing 7020 bent U profile 783217-2   | radius at upper web flange                   | 88,7            | R                   |              | 5136                                  | 890<br>addition al troop operational hours                            | 81/21.7<br>Kap. 4.1              | similar to damage F26, F63. exchange | A              |
| F33        | right wing 7210 upper wing skin 783193-2  | cover for aileron servo                      | 94              | R                   |              | 135,0                                 | 4076  | 81/21.4<br>Kap. 3.2              | exchange                             | A              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
VR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.             | Description of damage location                                    | Wing station WS | Damage  |              | Determined after number of test hours | TCTP component hours                    | Explanation, see IABG report no. | Remarks and measures taken                 | Classification |
|------------|---|---|-----------------|---------|--------------|---------------------------------------|---|----------------------------------|--|----------------|
|            |   |   |                 | Type 1) | Direction 2) | Size (mm)                             |   |                                  |  |                |
| F33        | left wing 7210 upper wing skin 783193-1   |   |                 | R       |              | 66,0                                  | 3916                                    |                                  | exchange similar to damage F2, F48         |                |
| F34        | right wing 7210 lower wing skin 783 194-2 | holes for the extension of beam 11A                               | 93,5            | R       |              | 0,2<br>3,2                            | 4326<br>5107                            | 81/21.4<br>Kap. 3.1.5.1          |  | C              |
| F35        | right wing 7210 rear bar 760 315R         | at the repair point in the rounding radius between flange and web | 88,9            | R       |              | 22,0                                  | 2454                                    | 81/21.10<br>Kap. 2.2             | similar to damage F19, F39, F62            | A              |
| F36        | right wing 7210 end rib 783 460-2         | rivet mother plate hole for position lamp attachment              | 131             | R       |              | 1,2 + 3,4                             | 2454 additional troop operational hours | 81/21.10<br>Kap. 3.1             | similar to damage F2. exchange             | C              |
| F37        | right wing 7210 end rib 783 460-2         | radius of the flange-web intersection edge                        | 131             | R       |              | 45,0                                  | 2454 additional troop operational hours | 81/21.10<br>Kap. 3.2             | similar to damage F52, F53, F54. exchange. | B              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABR = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.                                   | Description of damage location   | Wing station WS | Type 1) Direc- tion 2) (mm) | Determined after number of test hours | TCIF comp- onent hours           | Explan- ation, see IADG report no. | Remarks and measures taken   | Classifi- cation |
|------------|---|--|-----------------|-----------------------------|---------------------------------------|----------------------------------|------------------------------------|--|------------------|
| F38        | left wing 7210 lower wing skin 783 194-1                        | beginning cracks in the countersunk holes of the skin fitting connection | 34 - 40         | RV iF/gf                    | 6064                                  | 4654                             | -                                  | crack propa- gation  | -                |
| F39        | left wing 7210 rear spar 760 315-1                              | rounding radius web-flange   | 83,9            | R R                         | 6064                                  | 4654                             | 81/21.10 Kap. 2.2                  | similar to damage F19, F35, F62. Repair                            | A                |
| F40        | left wing 7210 lower wing skin 783 194-1                        | inner pylon fitting connection region                                    | 63,7            | R iF/gf                     | 6064                                  | 4654                             | 81/21.4 Kap. 3.1.2.2               | similar to damage F44  | X                |
| F41        | left wing 7210 lower wing skin 783 194-1                        | connection of beam 10, hole 13   | 59,7            | R RV RV R                   | 6064 7257 8687 8687                   | 4654 5504 6934 6934              | 81/21.4 Kap. 3.1.3.4               | similar to damage F6, F44, F60, F65                                | A                |
| F42        | left wing 2710 fittings 783 196-1 783 197-1 783 198-1 783 199-1 | Fitting No. 2 Fitting No. 3 Fitting No. 4 Fitting No. 5                  | 36 + 48         | R iF/gf                     | <0,5 0,2+1,4 0,3+1,2 0,3+2,4          | 2064 2064 2064 2064              | 81/21.8 ASB 7 ASB 13 ASB 20 ASB 31 | similar to damage F10, F12, F13, F14, F15, F22, F28, F46, F67, F68 | X                |
| F43        | left wing 2003 lower wing skin 783 194-1                        | radius of milling for landing flap hing                                  | 91              | R RM                        | 6744                                  | 1280 + broop op- erational hours | 81/21.10 Kap. 2.1                  | similar to damage F20, F30   | A                |

Kap = chapter

ABB = figure

1 = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

2) 0 = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

1) R = crack

B = fracture

RV = crack extension



TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Section or component part no. | Description of damage location   | Wing station WS    | Damage  |              | Determined after number of test hours | TCIP component hours                 | Explanation, see TABG report no.                         | Remarks and measures taken   | Classification |
|-------------------------------|--|--------------------|---------|--------------|---------------------------------------|--------------------------------------|--|--|----------------|
|                               |  |                    | Type 1) | Direction 2) |                                       |                                      |  |  |                |
| F43                           | rear spar 760 315-1  | 89                 | R       | i.F.         | 6344                                  | 1280 + troop operational hours       | 81/21.10 Kap.2.3   | similar to damage F19, F35, F62, F39                               | A              |
| F44                           | right wing 7210 lower wing skin 783 194-2                                  | 63 + 67<br>48 + 72 | B<br>R  | i.F./g.F.    | 6407<br>6407                          | 5107<br>5107                         | 81/21.4 Kap.3.1.2.1 Kap.3.1.3.1                          | similar to damage F40, F16, F24, F17, F65                          | X              |
| F45                           | right wing 7210 landing flap 784 670-4                                     | 36 + 43,1          | B       |              | 6407                                  | 5107                                 | -  | flap was taken apart   | C              |
| F46                           | right wing 7210 fittings 783 195-2 783 196-2 783 197-2 783 198-2 783 199-2 | 36 + 47            | R       | i.F./g.F.    | 6407<br>6407<br>6407<br>6407<br>6407  | 5107<br>1771<br>1771<br>1771<br>1771 | 81/21.8<br>ABB 5<br>ABB 11<br>ABB 18<br>ABB 26<br>ABB 38 | similar to damage F1C, F12, F13, F14, F15, F22, F23, F42, F67, F68 | X              |
| F47                           | left wing 7210 upper wing skin 783 193-1                                   | 63,7               | R       |              | 6466                                  | 4773                                 | 81/21.4 Kap.3.2.1.2                                      |  | C              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.            | Description of damage location                         | Wing station WS | Damage                         |  | Determined after number of test hours        | TCTP component hours                         | Explanation, see IAFG report no. | Remarks and measures taken   | Classification |
|------------|--|--|-----------------|--------------------------------|--|--|--|----------------------------------|--|----------------|
|            |  |  |                 | Type 1)                        | Direction 2) (mm)                                  |  |  |                                  |  |                |
| F48        | right wing 7020 upper wing skin 783193-1 | cover for aileron block, crack in radius of depression | 74,5            | R                              | 27   | 6724   | 2288   | 81/21.4 Appendix A               | made up from wing 7210 at 6047 hours, similar to damage F2, F33, F48 | A              |
| F49        | left wing 7210 lower wing skin 783 194-1 | hole for attaching the pylon fuel tank connection      | 73,5            | R                              | 27,0   | 6724   | 4971   | 81/21.4 Kap. 3.1.4.2             | including $\varnothing$ 6.3 mm hole                                  | X              |
| F50        | left wing 7210 lower wing skin 783 194-1 | hole for attaching electrical connection               | 73,5            | R                              | 7,0  | 7007   | 5254   | 81/21.4 Kap. 3.1.4.2             |  | C              |
| F51        | left wing 7210 bent U profile 783 217-7  | radius at the upper web flange                         | 88,7            | R                              | 12,0   | 7108   | 2765   |                                  | similar to damage F3, F7, F23, F29                                   | A              |
| F52        | left wing 7210 end rib 783460-1          | radius of the flange-web intersection edge             | 131             | R<br>R<br>RV<br>RV<br>RV<br>RV | o 1,9<br>u 1,6<br>o 2,5<br>u 2,8<br>o 3,2<br>u 3,5 | 7108<br>7108<br>7216<br>7216<br>7469<br>7469 | 5355<br>5355<br>5463<br>5463<br>5716<br>5716 | 81/21.10 Kap. 3.2                | similar to damage F37, F53, F54 as an extension to R52               | B              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.             | Description of damage location             | Wing station WS | Damage  |                      | Determined after number of test hours | TCTP component hours              | Explanation, see IABG report no. | Remarks and measures taken | Classification |
|------------|---|--|-----------------|---------|----------------------|---------------------------------------|-----------------------------------|----------------------------------|----------------------------|----------------|
|            |   |  |                 | Type 1) | Direction 2) (mm)    |                                       |                                   |                                  |                            |                |
| F53        | right wing 7020 end rib 783 460-2         | radius of the flange-web intersection edge | 131             | R       | 0 1,5                | 7103                                  | 1591 +                            | 81/21.10 Kap. 3.2                | F37, F52, F54              | 8              |
|            |   |  |                 | R       | u 1,3                | 7108                                  | 1591 +                            |                                  |                            |                |
|            |   |  |                 | RV      | o 3,5                | 7469                                  | 1852 +                            |                                  |                            |                |
|            |   |  |                 | RV      | u 2,3                | 7469                                  | 1952 +                            |                                  |                            |                |
|            |   |  |                 | RV      | o 4,0                | 7805                                  | 2288 +                            |                                  |                            |                |
| F54        | left wing 7210 end rib 733 460-1          | radius of the flange-web intersection edge | 131             | R       | o 2,5                | 7216                                  | 5463                              | 81/21.10 Kap. 3.2                | see damage F37, F52, F53   | 8              |
|            |   |  |                 | RV      | u 2,8                | 7216                                  | 5463                              |                                  |                            |                |
| F55        | left wing 7210 lower wing skin 783 194-1  | countersunk hole at beam 10, hole No. 13   | 59,7            | R       | g.F. 4,1<br>i.F. 0,8 | 7257                                  | 5914                              |                                  | crack propagation          | A              |
|            |   |  |                 |         |                      |                                       |                                   |                                  |                            |                |
| F56        | left wing 7210 lower wing skin 783 194-1  | countersunk hole 24 in fitting 3 range     | 36              | R       | i.F. 0,3<br>g.F. 0,8 | 7469                                  | 6136                              |                                  | crack propagation          | -              |
|            |   |  |                 |         |                      |                                       |                                   |                                  |                            |                |
| F57        | right wing 7020 lower wing skin 783 194-2 | tip tank bolt region                       | 131             | R       | < 0,5                | 7469                                  | 1952 +<br>troop operational hours | 81/21.4 Kap. A                   |                            | C              |

Kap = chapter  
ABB = figure

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

2) o = upwards

u = downwards

NR = several cracks

i.F. = in flight direction

g.F. = against flight direction

1) R = crack

B = fracture

RV = crack extension

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.            | Description of damage location   | Wing station WS | Damage                                       |  | Determined after number of test hours                              | TCTP component hours   | Explanation, see IABG report no. | Remarks and measures taken               | Classification |
|------------|--|--|-----------------|--|--|--|--|----------------------------------|--|----------------|
|            |  |  |                 | Type 1)                                      | Direction 2)(mm)   |  |  |                                  |  |                |
| F58        | left wing 7210 lower wing skin 783 194-1 | countersunk holes in fitting No. 3 region  | 46              | RV   | if/gf 0,5 + 4  | 7596   | 5843   | -                                | extension of damage F24                  | A              |
| F59        | left wing 7210 lower wing skin 783 194-1 | attachment holes of the aileron servo at the skin Hole 2<br>Hole 3<br>Hole 4<br>Hole 6 | 73 + 84,2       | R<br>RV<br>R<br>RV<br>R<br>R<br>RV<br>R<br>R | g.F.<br>g.F.<br>g.F.<br>g.F.<br>g.F.<br>g.F.<br>g.F.<br>i.F.<br>g.F.<br>i.F. | 1,6<br>2,5<br>0,8<br>5,8<br>1,3<br>3,5<br>3,6<br>1,8<br>4,6<br>1,4 | 5843<br>6934<br>5843<br>6934<br>6934<br>5843<br>6934<br>6934<br>6934<br>6934 | 81/21.4<br>Kap.3.1.5.2           |  | A              |
| F60        | left wing 7210 lower wing skin 783 194-1 | Jo-Bolt hole ahead of fitting 3 above the canted rib                                   | 48              | R<br>RV<br>RV<br>RV                          | g.F.<br>g.F.<br>g.F.<br>g.F.   | 7596<br>8642<br>8650<br>8687                                       | 5843<br>6889<br>6897<br>6934   | 81/21.4<br>Kap.3.1.3.2           | similar to damage F6, F41, F44, F61, F65 | A              |
| F61        | left wing 7210 lower wing skin 783 194-1 | beam 8, Jo-Bolt hole 10 — 14   | 62 + 66         | R  | if/gf 0,5 + 4,5  | 7804   | 6051   | 81/21.4<br>Kap.3.1.3.2           | similar to damage F6, F41, F44, F60, F65 | A              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.                                    | Description of damage location   | Wing station WS | Damage  |              | Determined after number of test hours | TCIP component hours  | Explanation, see JABG report no.                       | Remarks and measures taken               | Classification |
|------------|--|--|-----------------|---------|--------------|---------------------------------------|---|--|--|----------------|
|            |  |  |                 | Type 1) | Direction 2) |                                       |   |  |  |                |
| F62        | right wing 7020 rear spar 760 315R                               | rounding radius flange-web   | 88,9            | R       | SN           | 7805                                  | 2288 + troop operational hours                                  | 81/21.10 Kap. 2.2                                      | similar to damage F19, F35, F39          | A              |
| F63        | right wing 7020 bent U profile 783 217-8                         | radius in the upper web flange   | 88,7            | R       |              | 7805                                  | 1398  | 81/21.7 Kap. 4.1                                       | similar to damage F26, F32               | A              |
| F64        | right wing 7020 fittings 783 196-2 783 197-2 783 198-2 783 199-2 | Fitting No. 2<br>Fitting No. 3<br>Fitting No. 4<br>Fitting No. 5         | 36 + 48         | R       | iF/gf        | 7805<br>7805<br>7805<br>7805          | 2288 +<br>2288 +<br>2288 +<br>2288 +<br>troop operational hours | 81/21.8 Kap. A<br>ABB A1<br>ABB A2<br>ABB A3<br>ABB A4 |  | X              |
| F65        | left wing 7210 lower wing skin 783 194-1                         | countersunk holes in fitting connection region and canting rib II region | 36 + 47<br>48   | R       | iF/gf        | 8687                                  | 6934  | 81/21.4  | similar to damage F6, F41, F44, F60, F65 | A              |
| F66        | left wing 7210 lower wing skin 783 194-1                         | beam 8, Jo-Bolt hole 13  | 60              | R       | g.F.         | 8515                                  | 6762  |  | extension to damage F41                  | A              |

1) R = crack

B = fracture

RV = crack extension

2) O = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B1. DAMAGE TO BASIC WINGS (continued)

| Damage no. | Section or component part no.  | Description of damage location                                   | Wing station WS | Damage  |   | Determined after number of test hours | TCTP component hours         | Explanation, see IABC report no.              | Remarks and measures taken   | Classification |
|------------|--|--|-----------------|---------|---|---------------------------------------|------------------------------|---|--|----------------|
|            |  |  |                 | Type 1) | Direction 2) (mm)                               |                                       |                              |   |  |                |
| F67        | left wing<br>7210 fitting<br>5, 783 199-1                                      | fracture of fitting 5  | 36 + 47         | 3       |   | 8687                                  | 2280                         | 81/21.8                                       | similar to damage F10, F12, F13, F14, F15, F22, F28, F42, F46, F68 termination of test with basic wing | X              |
| F68        | left wing<br>7210 fittings<br>783 195-1<br>783 196-1<br>783 197-1<br>783 198-1 | Fitting No. 1<br>Fitting No. 2<br>Fitting No. 3<br>Fitting No. 4 | 36 + 47         | R       | if/df<br><br>0.24i,0<br><0.5<br><0.5<br>0.5x2,0 | 8687<br>8687<br>8687<br>8687          | 6934<br>2280<br>2280<br>2280 | 81/21.8<br>ABB 3<br>ABB 8<br>ABB 14<br>ABB 21 | similar to damage F10, F12, F13, F14, F15, F22, F28, F42, F46, F67                                     | X              |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.H. = to fuselage center

Kap = chapter

ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS

| Damage no. | Section of component part no.            | Description of damage location  | Wing station WS | Damage                               |  | Determined after number of test hours                       | TCIP component and other hours                         | Explanation, see IABC report no. | Remarks and measures taken   | Classification |
|------------|--|---|-----------------|--------------------------------------|--|---|--|----------------------------------|--|----------------|
|            |  |   |                 | Type 1)                              | Direction 2) (mm)                                    |   |  |                                  |  |                |
| RF1        | left wing 7210 tip tank                  | sleeve for tip tank alignment bolt  | 131.0           | R                                    | a  | 8978  | 7952   | 81/21.7 Kap. 4.2                 | exchanged at 9705 total test hours. damage similar to RF25, RF26, RF28, RF30 | C              |
| RF2        | left wing 7210 upper wing skin 783193-1  | milling radius at the aileron servo cover opening   | 95.2            | R                                    |  | 9705  | 7952   | 81/21.5 Kap. 3.2.1               | repair with reinforcement plate similar to damage RF18                       | A              |
| RF3        | left wing 7210 bent U profile 783217-101 | between beam 14 and aileron servo block radius at the upper web flange  | 88.7            | R                                    | g.F.   | 9705  | 1018   | 81/21.7 Kap. 4.1                 | reinforced version, part exchanged, similar to damage RF17                   | A              |
| RF4        | right wing 8166, fitting 783199-2        | Fitting No. 5<br>Hole No. 1<br>Hole No. 1<br>Hole No. 1<br>Hole No. 1<br>Hole No. 1<br>Hole No. 1<br>Hole No. 1 | 37.0            | R<br>RV<br>RV<br>R<br>RV<br>RV<br>RV | g.F.<br>g.F.<br>g.F.<br>i.F.<br>g.F.<br>i.F.<br>g.F. | 11559<br>11705<br>12702<br>12703<br>12825<br>13056<br>13056 | 2872<br>3018<br>4015<br>4015<br>4138<br>4,369<br>4,369 | 81/21.9 Kap. 3.1.10              | similar to damage RF5, RF6, RF7, RF8, RF9, RF10, RF11, RF12, RF16            | X              |

1) R = crack  
B = fracture  
RV = crack extension

2) u = upwards  
o = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

1 = inwards  
a = outwards  
I.S. = in span direction  
R.H. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.          | Description of damage location | Wing station WS | Damage  |                   | Determined after number of test hours | TCTP component and other hours | Explanation, see IABG report no. | Remarks and measures taken   | Classification |
|------------|--|--------------------------------|-----------------|---------|-------------------|---------------------------------------|--------------------------------|----------------------------------|--|----------------|
|            |  |                                |                 | Type 1) | Direction 2) (mm) |                                       |                                |                                  |  |                |
| RF5        | right wing<br>8166 fitting<br>783199-2 | Fitting No. 5                  | 37              | R       | g.f.              | 1559                                  | 2872                           | 81/21.9<br>Kap. 3.1.10           | similar to damages RF4, RF6, RF7, RF8, RF9, RF10, RF11, RF12, RF16 | X              |
|            |  | Hole No. 12                    |                 | RV      | g.f.              | 11705                                 | 3018                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | R       | i.f.              | 12702                                 | 4015                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | i.f.              | 12825                                 | 4138                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | g.f.              | 12825                                 | 4138                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | i.f.              | 13056                                 | 4369                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | g.f.              | 13056                                 | 4369                           |                                  |  |                |
| RF6        | left wing 7210 fitting<br>783199-1     | Fitting No. 5                  | 37              | R       | i.f.              | 11559                                 | 2872                           | 81/21.9<br>Kap. 3.1.9            | similar to damages RF4, RF5, RF7, RF8, RF9, RF10, RF11, RF12, RF16 | X              |
|            |  | Hole No. 12                    |                 | R       | g.f.              | 11559                                 | 2872                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | i.f.              | 12825                                 | 4138                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | g.f.              | 12825                                 | 4138                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | i.f.              | 13056                                 | 4369                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | g.f.              | 13056                                 | 4369                           |                                  |  |                |
|            |  | Hole No. 12                    |                 | RV      | g.f.              | 13056                                 | 4369                           |                                  |  |                |
| RF7        | right wing<br>8166 fitting<br>783198-2 | Fitting No. 4                  | 37              | R       | i.f.              | 12702                                 | 4015                           | 81/21.9<br>Kap. 3.1.8            | similar to damages RF4, RF5, RF6, RF8, RF9, RF10, RF11, RF12, RF16 | X              |
|            |  | Hole No. 1                     |                 | RV      | i.f.              | 13056                                 | 4369                           |                                  |  |                |
|            |  |                                |                 | R       | i.f.              | 14369                                 | 6182                           |                                  |  |                |
|            |  |                                |                 |         |                   |                                       |                                |                                  |  |                |
|            |  |                                |                 |         |                   |                                       |                                |                                  |  |                |
| RF8        | right wing<br>8166 fitting<br>783198-2 | Fitting No. 4                  | 37              | R       | i.f.              | 12702                                 | 4015                           | 81/21.9<br>Kap. 3.1.8            | similar to damages RF4, RF5, RF6, RF7, RF9, RF10, RF11, RF12, RF16 | X              |
|            |  | Hole No. 10                    |                 | RV      | i.f.              | 14964                                 | 6182                           |                                  |  |                |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.f. = in flight direction  
g.f. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = Chapter  
ABB = figure



TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.          | Description of damage location              | Wing station WS | Damage             |  | Determined after number of test hours | TCTP component and other hours | Explanation, see IABG report no. | Remarks and measures taken   | Classification |
|------------|--|---|-----------------|--------------------|--|---------------------------------------|--------------------------------|----------------------------------|--|----------------|
|            |  |   |                 | Type 1)            | Direction 2) (mm)  |                                       |                                |                                  |  |                |
| RF9        | right wing<br>8166 fitting<br>783198-2 | Fitting No. 4<br>Hole No. 10                | 37              | R<br>RV            | i.f.<br>i.f.<br>0,5<br>1,5                               | 12702<br>14869                        | 4015<br>6182                   | 81/21.9<br>Kap. 3.1.8            | similar to damages RF4, RF5, RF6, RF7, RF8, RF10, RF11, RF12, RF16 | X              |
| RF10       | left wing<br>7210 fitting<br>783198-1  | Fitting No. 4<br>Hole No. 1                 | 37              | R<br>RV<br>R       | i.f.<br>i.f.<br>g.f.<br>0,5<br>1,5<br>0,5                | 12702<br>14869<br>14869               | 4015<br>6182<br>6182           | 81/21.9<br>Kap. 3.1.7            | similar to damages RF4, RF5, RF6, RF7, RF8, RF9, RF11, RF12, RF16  | X              |
| RF11       | left wing<br>7210 fitting<br>783198-1  | Fitting No. 2<br>Hole No. 16<br>Hole No. 16 | 37              | R<br>R<br>RV<br>RV | i.f.<br>g.f.<br>i.f.<br>g.f.<br>0,4<br>0,6<br>2,4<br>3,5 | 12702<br>12702<br>14869<br>14869      | 4015<br>4015<br>6182<br>6182   | 81/21.9<br>Kap. 3.1.3            | similar to damages RF4, RF5, RF6, RF7, RF8, RF9, RF10, RF12, RF16  | X              |
| RF12       | left wing<br>7210 fitting<br>783198-1  | Fitting No. 4<br>Hole No. 18<br>Hole No. 18 | 37              | R<br>R<br>RV<br>RV | i.f.<br>g.f.<br>i.f.<br>g.f.<br>0,4<br>0,4<br>1,6<br>1,4 | 12702<br>12702<br>14869<br>14869      | 4015<br>4015<br>6182<br>6182   | 81/21.9<br>Kap. 3.1.7            | damage similar X to RF4, RF5, RF6, RF7, RF8, RF9, RF10, RF11, RF16 | X              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.f. = in flight direction  
g.f. = against flight direction

i = inwards  
a = outwards  
i.s. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.  | Description of damage location                       | Wing station WS | Damage  |                   | Determined after number of test hours | TCTP component and other hours  | Explanation, see IABC report no. | Remarks and measures taken  | Classification |
|------------|--------------------------------|--|-----------------|---------|-------------------|---------------------------------------|---------------------------------|----------------------------------|---|----------------|
|            |                                |  |                 | Type 1) | Direction 2) (mm) |                                       |                                 |                                  |   |                |
| RF13       | right wing 7210 hinge 784670-4 | hinge bands on wing side for landing flap connection | 47.3 +          | B       |                   | 17702                                 | 7185 TCTP + approx. 1000 troops | 81/21.7 Kap. 2.4.2               | on 15 hinge members. similar to damages RF14, RF20, RF35, RF37, RF43. Component was exchanged | A              |
|            |                                |  | 59.6            |         |                   |                                       |                                 |                                  |   |                |
|            |                                |  | 62.0            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 62.7            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 63.2            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 65.0            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 65.6            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 66.7            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 67.0            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 67.7            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 68.1            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 68.4            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 69.4            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 71.2            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 75.1            |         | i.F.              |                                       |                                 |                                  |   |                |
| RF14       | left wing 7210 hinge 784670-3  | hinge bands on wing side for land flap connection    | 44.6 +          | B       |                   | 17702                                 | 6934 basis + 4015 retrofit      | 81/21.7 Kap. 2.4                 | 4 hinge members broken. similar to damages RF13, RF20, RF35, RF37                             | A              |
|            |                                |  | 47              |         |                   |                                       |                                 |                                  |   |                |
|            |                                |  | 66.3            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  | 78.7            |         | i.F.              |                                       |                                 |                                  |   |                |
|            |                                |  |                 |         |                   |                                       |                                 |                                  |   |                |
|            |                                |  |                 |         |                   |                                       |                                 |                                  |   |                |
|            |                                |  |                 |         |                   |                                       |                                 |                                  |   |                |
|            |                                |  |                 |         |                   |                                       |                                 |                                  |   |                |
|            |                                |  |                 |         |                   |                                       |                                 |                                  |   |                |
|            |                                |  |                 |         |                   |                                       |                                 |                                  |   |                |
|            |                                |  |                 |         |                   |                                       |                                 |                                  |   |                |

1) R = crack

B = fracture

RV = crack extension

o = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.             | Description of damage location  | Wing station WS | Damage  |              | Determined after number of test hours | TCTP component and other hours | Explanation, see IABG report no. | Remarks and measures taken                                       | Classifications |
|------------|---|---|-----------------|---------|--------------|---------------------------------------|--------------------------------|----------------------------------|--|-----------------|
|            |   |   |                 | Type 1) | Direction 2) | Size (mm)                             |                                |                                  |  |                 |
| RF14       |   |   |                 |         |              |                                       |                                |                                  | RF37, RF43 Component was exchanged                               |                 |
| RF15       | left wing 7210 lower wing skin 789194-1   | rear hole for attaching fuel connection for pylon tank (pylon manifold) | 73,5            | R       | i.F.         | 2,5                                   | 12702                          | 8/21.5 Kap.3.1.4                 | similar to damage RF41   | X               |
|            |   |   |                 | RV      | g.F.         | 1,5                                   | 4015                           |                                  |  |                 |
|            |   |   |                 | RV      | g.F.         | 1,8                                   | 4762                           |                                  |  |                 |
|            |   |   |                 | RV      | i.F.         | 5,5                                   | 4898                           |                                  |  |                 |
|            | right wing 8166 789194-2                  |   | 73,5            | R       | g.F.         | 4,0                                   | 6182                           | 8/21.5 Kap.3.1.4                 | crack was milled away and reinforced with repair plate           |                 |
| RF16       | left wing 7210 fitting 783199-1           | Fitting No. 5 Hole No. 1  | 37              | R       | g.F.         | 0,8                                   | 14869                          | 8/21.9 Kap.3.1.9                 | similar to damage RF4, RF5, RF6, RF7, RF8, RF9, RF10, RF11, RF12 | X               |
|            |   |   |                 |         |              |                                       | 6102                           |                                  |  |                 |
| RF17       | right wing 8166 bent U profile 783217-102 | between beam 14 and aileron block                                       | 88.7            | R       |              | 27,0<br>17,0                          | 13056                          | 8/21.7 Kap.4.1.2                 | upper flange, lower flange similar to damage RF3                 | A               |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.            | Description of damage location                              | Wing station WS | Damage  |                   | Determined after number of test hours | TCTP component and other hours | Explanation, see IABC report no. | Remarks and measures taken   | Classification |
|------------|--|---|-----------------|---------|-------------------|---------------------------------------|--------------------------------|----------------------------------|--|----------------|
|            |  |   |                 | Type 1) | Direction 2) (mm) |                                       |                                |                                  |  |                |
| RF18       | right wing 8166 upper wing skin 783193-2 | opening for aileron servo for accepting cover               | 95,5            | R       | 77,0              | 13056                                 | 4369                           | 81/21.5                          | repaired. similar to damage RF2 + 1342 troops                        | A              |
|            | aileron servo cover 786426-2             | in the center part of the rounding radius                   | 91,5            | RV      | 90,0              | 14869                                 | 6182                           | Kap. 3.2.1                       |  | A              |
| RF19       | left wing 7210 front spar 783192-1       | upper rounding radius on the side of the flap               | 39 + 42,2       | R       | 80,0              | 13056                                 | 4369                           | 81' 1.7                          | repaired according to CAF.T.O 1F-1046/3. similar to damage RF36, F44 | B              |
|            | left wing 7210 nose flap 784588-3        | nose box spar in web-flange region and at the hinge members | 38 + 46,7       | B       |                   | 13056                                 | 109                            |                                  | was inged. similar to damages RF13, RF14, RF35, RF37, RF43           | B              |
| RF21       | left wing 7210 lower wing skin 783194-1  | countersunk holes of the inner pylon fitting connection     |                 |         |                   |                                       | 4369                           | 81/21.5                          | similar to damage RF22   | X              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no. | Description of damage location                          | Wing station WS | Damage  |              | Determined after number of test hours | TCTP component and other hours | Explanation, see IABG report no. | Remarks and measures taken | Classification |
|------------|-------------------------------|---|-----------------|---------|--------------|---------------------------------------|--------------------------------|----------------------------------|----------------------------|----------------|
|            |                               |   |                 | Type 1) | Direction 2) | Size (mm)                             |                                |                                  |                            |                |
| RF21       |                               | Hole 1  | 63,7            | R       | i.f.         | 2,5                                   | 13056                          | Kap.3.1.2                        |                            |                |
|            |                               | Hole 1  | 63,7            | RV      | g.f.         | 2,9                                   | 14869                          | 6182                             |                            |                |
|            |                               | Hole 3  | 65,4            | RV      | i.f.         | 7,5                                   |                                |                                  |                            |                |
|            |                               | Hole 3  | 65,4            | R       | g.f.         | 8,0                                   | 13056                          | 4369                             |                            |                |
|            |                               | Hole 3  | 65,4            | R       | i.f.         | 0,8                                   |                                |                                  |                            |                |
|            |                               | Hole 5  | 66,3            | R       | g.f.         | 0,5                                   | 14869                          | 6182                             |                            |                |
|            |                               | Hole 5  | 66,3            | R       | i.f.         | 0,8                                   |                                |                                  |                            |                |
| RF22       |                               | Hole 5  | 66,3            | R       | g.f.         | 0,5                                   | 13056                          | 4369                             |                            |                |
|            |                               | Hole 5  | 66,3            | R       | i.f.         | 1,8                                   |                                |                                  |                            |                |
|            |                               | Hole 5  | 66,3            | R       | g.f.         | 0,4                                   | 14869                          | 6182                             |                            |                |
|            |                               | Hole 5  | 66,3            | RV      | i.f.         | 2,0                                   |                                |                                  |                            |                |
|            |                               | Hole 5  | 66,3            | RV      | g.f.         | 3,0                                   |                                |                                  |                            |                |
|            |                               | countersunk holes in the inner pylon fitting connection |                 |         |              |                                       |                                | 81/21.5                          | similar to damage RF21     |                |
|            |                               | Hole 1  | 63,7            | R       | i.f.         | 0,6                                   | 13056                          | 4369                             |                            |                |
|            |                               | Hole 1  | 63,7            | R       | g.f.         | 1,2                                   |                                |                                  |                            |                |
|            |                               | Hole 1  | 63,7            | RV      | i.f.         | 1,6                                   | 14869                          | 6182                             |                            |                |
|            |                               | Hole 1  | 63,7            | RV      | g.f.         | 2,6                                   |                                |                                  |                            |                |
|            |                               | Hole 2  | 64,5            | R       | i.f.         | 0,4                                   | 13056                          | 4369                             |                            |                |
|            |                               | Hole 2  | 64,5            | RV      | i.f.         | 0,4                                   | 14869                          | 6182                             |                            |                |
|            |                               | Hole 3  | 64,5            | R       | i.f.         | 0,2                                   | 13056                          | 4369                             |                            |                |
| RF22       |                               | Hole 3  | 64,5            | RV      | i.f.         | 0,2                                   | 14869                          | 6182                             |                            |                |
|            |                               | Hole 4  | 66,3            | R       | g.f.         | 0,8                                   |                                |                                  |                            |                |
|            |                               | Hole 4  | 66,3            | R       | i.f.         | 0,4                                   | 13056                          | 4369                             |                            |                |
|            |                               | Hole 4  | 66,3            | RV      | i.f.         | 0,8                                   | 14869                          | 6182                             |                            |                |

1)

R = crack

B = fracture

RV = crack extension

2)

o = upwards

u = downwards

MR = several cracks

i.f. = in flight direction

g.f. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.            | Description of damage location                           | Wing station WS | Damage        |                      | Determined after number of test hours | TCTP component and other hours | Explanation, see IABG report no. | Remarks and measures taken    | Classification |
|------------|--|--|-----------------|---------------|----------------------|---------------------------------------|--------------------------------|----------------------------------|-------------------------------|----------------|
|            |  |  |                 | Type 1)       | Direction 2)         |                                       |                                |                                  |                               |                |
| RF22       |  | Hole 5   | 66,3            | R             | i.F.                 | 3,5                                   | 4369                           |                                  |                               |                |
|            |  | Hole 5   | 66,3            | R<br>RV<br>RV | g.F.<br>i.F.<br>g.F. | 1,8<br>11,0<br>8,5                    | 6182                           |                                  |                               |                |
| RF23       | right wing 8166 lower wing skin 783194-2 | countersunk holes of the fitting skin connection region  | 36 + 48         | R             | i.F./g.F.            | 0,4+0,6                               | 4369                           | 81/21.5 Kap. 3.1.1.              | similar to damages RF24, RF38 | A              |
|            |  | Fitting No. 2  |                 | R             | i.F./g.F.            | 0,4+2,4                               | 6182                           |                                  |                               |                |
|            |  | Fitting No. 3  |                 | R             | i.F./g.F.            | 0,4+2,3                               | 4369                           |                                  |                               |                |
|            |  | Fitting No. 4  |                 | R             | i.F./g.F.            | 0,4+4,0                               | 6182                           |                                  |                               |                |
|            |  | Fitting No. 5  |                 | R             | i.F./g.F.            | 0,4+0,7                               | 4369                           |                                  |                               |                |
|            |  |  |                 | R             | i.F./g.F.            | 0,4+1,0                               | 6182                           |                                  |                               |                |
| RF24       | left wing 7210 lower wing skin 783194-1  | countersunk holes of the fitting skin connections region | 36 + 48         | R             | i.F./g.F.            | 0,4+1,2                               | 4369                           | 81/21.5 Kap. 3.1.1.              | similar to damage RF23 RF38   | A              |
|            |  | Fitting No. 2  |                 | R             | i.F./g.F.            | 0,4+1,2                               | 6182                           |                                  |                               |                |
|            |  | Fitting No. 3  |                 | R             | i.F./g.F.            | 0,4+0,6                               | 4369                           |                                  |                               |                |
|            |  | Fitting No. 4  |                 | R             | i.F./g.F.            | 0,5+2,5                               | 6182                           |                                  |                               |                |
|            |  |  |                 | R             | i.F./g.F.            | 0,4+1,3                               | 4369                           |                                  |                               |                |
|            |  |  |                 | R             | i.F./g.F.            | 0,4+2,0                               | 6182                           |                                  |                               |                |

- 1) R = crack  
B = fracture  
RV = crack extension
- 2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction
- i = inwards  
a = outwards  
i.S. = in span direction  
i.M. = to fuselage center
- Kap = chapter  
ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.           | Description of damage location  | Wing station WS | Damage        |                      |                             | Determined after number of test hours | TCIP component and other hours | Explanation, see IABC report no. | Remarks and measures taken  | Classification |
|------------|---|---|-----------------|---------------|----------------------|-----------------------------|---------------------------------------|--------------------------------|----------------------------------|---|----------------|
|            |   |   |                 | Type 1)       | Direction 2)         | Size (mm)                   |                                       |                                |                                  |   |                |
| RF24       |   | Fitting No. 5   |                 | R             | i.f./g.f.            | 0,4<br>0,4+1,5              | 13056<br>14869                        | 4369<br>6182                   |                                  |   |                |
| RF25       | left wing 7210 end rib 783460-1         | upper and lower transition radius from the shackle to the U profile at the rear spar connection | 131             | R             | o<br>u               | 3,0<br>4,0                  | 13449                                 | 4762                           | 81/21.7 Kap.4.2                  | end rib was exchanged. similar to damages RF1, RF26, RF28, RF30     | B              |
| RF26       | left wing 7210 end rib 783460-1         | hole for connecting the position light  | 131             | R             | i.f.<br>i.f.         | 2,0<br>4,0                  | 13449                                 | 4762                           | 81/21.7 Kap.4.2                  | end rib was exchanged. similar to damages RF1, RF25, RF28, RF30     | C              |
| RF27       | left wing 7210 lower wing skin 783194-1 | transition radius of the depression for the landing flap hinge                                  | 91,0            | R<br>RV<br>RV | R.M.<br>R.M.<br>R.M. | 1,0<br>12,0<br>20,0<br>40,0 | 13449<br>13585<br>14093<br>14869      | 4762<br>4898<br>5406<br>6182   | 81/21.5 Kap.3.1.5                | similar to damage RF34  | A              |
| RF28       | left wing 7210 tip tank 729477-1        | sleeve for tip tank alignment bolts   | 131             | R             |                      | 26,0                        | 13823                                 | 4118                           | 81/21.7 Kap.4.2                  | similar to damages RF1, RF25, RF26, RF30. crack in radius, exchange | C              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.f. = in flight direction  
g.f. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.             | Description of damage location   | Wing station WS | Damage  |                   | Determined after number of test hours | TCTP component and other hours | Explanation, see IABG report no. | Remarks and measures taken               | Classification |
|------------|---|--|-----------------|---------|-------------------|---------------------------------------|--------------------------------|----------------------------------|--|----------------|
|            |   |  |                 | Type 1) | Direction 2) (mm) |                                       |                                |                                  |  |                |
| RF29       | left wing 7210 lower wing skin 783194-1   | crack starting at the radius of the aileron servo cylinder unit at WS91 ends at the locking opening of the nose flap | 91 + 92         | 8       | i.f.              | 14869                                 | 6182                           | 81/21.5 Kap.3.1.6                |  | B              |
| RF30       | right wing 8166 end rib 783460-2          | upper transition radius from the shackle to the U profile at the front spar connection                               | 131             | R       | 0                 | 14869                                 | 6182 ICP + 1342 troop          | 81/21.7 Kap.4.2.2                | similar to damages RF1, RF25, RF26, RF28 |                |
| RF31       | right wing 8166 rear spar 783460-2        | rounding radius web-lower flange   | 88,9            | R       | R.M.              | 14869                                 | 6182                           | 81/21.7 Kap.3.2.2                |  | A              |
| RF32       | right wing 8166 cylindrical unit 775256-2 | cylinder unit of the aileron servo at the radius of the flange depression  | 91              | R       |                   | 14869                                 | 6182 ICP + 1342 troop          | 81/21.7 Kap.4.3.2                | similar to damage RF39                   | B              |
| RF33       | right wing 8166 lower wing skin 783194-2  | beam No. 7, Jo-Bolt hole No. 18  | 65,3            | R       | i.f.              | 14869                                 | 6182                           | 81/21.5 Kap.3.1.3                |  | A              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.f. = in flight direction  
g.f. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure



TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.            | Description of damage location                                 | Wing station MS                | Damage           |                            | Determined after number of test hours | TCTP component and other hours | Explanation, see IABC report no. | Remarks and measures taken   | Classification |
|------------|--|--|--------------------------------|------------------|----------------------------|---------------------------------------|--------------------------------|----------------------------------|--|----------------|
|            |  |  |                                | Type 1)          | Direction 2) (mm)          |                                       |                                |                                  |  |                |
| RF34       | right wing 8166 lower wing skin 783194-2 | transition radius of the depression for the landing flap hinge | 91,0                           | R                | R.M.                       | 14869                                 | 6182                           | 81/21.5 Kap.3.1.5                | damage similar to RF27   | A              |
| RF35       | right wing 8166 hinge 784670-4           | hinge band on the wing side for the landing flap connection    | 54,5 + 57,3                    | B                |                            | 14869                                 | 2167 TCIP + 1063 Troop         | 81/21.7 Kap.2.4.2                | similar to damages RF13, RF14, RF20, RF37, RF43 5 hinge members broken | B              |
| RF36       | right wing 8166 front spar 783192-2      | 4 cavities for hinge units                                     | 72,5<br>74,0<br>76,0<br>88,0   | R<br>R<br>R<br>R | 10,0<br>5,0<br>7,0<br>11,0 | 14869                                 | 6182 TCIP + 1342 troop         | 81/21.7 Kap.3.1.2                | similar to damages RF19, RF44  | B              |
| RF37       | right wing 8166 nose flap 784588-4       | 4 hinge units broken   | 80,0<br>88,5<br>129,0<br>130,0 | B<br>B<br>B<br>B |                            | 14869                                 | 1342 TCIP + 1342 troop         | 81/21.7 Kap.2.4.2                | similar to damages RF13, RF14, RF20, RF35, RF43                        | B              |
| RF38       | right wing 8166 lower wing skin 783194-2 | Jo-Bolt holes at canted rib II                                 | 48                             | R                | i.F./g.F. 0,5*3,2          | 14869                                 | 6182                           | 81/21.5 Kap.3.1.1                | similar to damages RF23, RF24  | A              |
| RF39       | left wing 7210 cylindrical unit 775256-1 | cylinder unit of aileron servo, in milled radius of flange     | 91                             | B                |                            | 14869                                 | 13116                          | 81/21.7 Kap.4.3.1                | similar to damage RF32   | B              |

1)

R = crack

B = fracture

RV = crack extension

0 = upwards

u = downwards

MC = several cracks

i.F. = in flight direction

g.F. = against flight direction

1 = inwards

a = outwards

I.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.           | Description of damage location   | Wing station WS   | Damage                          |                   | Determined after number of test hours | TCTP component and other hours | Explanation, see IABG report no. | Remarks and measures taken                      | Classification |
|------------|---|--|---|---------------------------------|-------------------|---------------------------------------|--------------------------------|----------------------------------|---|----------------|
|            |   |  |   | Type 1)                         | Direction 2) (mm) |                                       |                                |                                  |   |                |
| RF40       | left wing 7210 beam                     | lower flange and web flange<br>Beam 4<br>Beam 5<br>Beam 6<br>Beam 7<br>Beam 8<br>Beam 9<br>Beam 10 | 95,65<br>95,18<br>94,40<br>96,52<br>93,05<br>91,20<br>91,91 | B<br>B<br>B<br>B<br>B<br>B<br>B |                   | 14869                                 | 13116                          | 81/21.7<br>Kap.2.1.1             |   | B              |
| RF41       | left wing 7210 lower wing skin 783194-1 | front hole for attaching the fuel connection for pylon tank (pylon manifold)                       | 74  | R<br>R                          | i.f.<br>g.f.      | 14869                                 | 6182                           | 81/21.5<br>Kap.3.1.4             | similar to damage RF15                          | X              |
| RF42       | left wing 7210 lower wing skin 783194-1 | hole for passing the rear shear pin  | 74  | R                               | g.f.              | 14869                                 | 6182                           | 81/21.5<br>Kap.3.1.4             |   | C              |
| RF43       | left wing 7210 nose flap 784588-3       | first hinge unit   | 39,7  | R                               | R.M.              | 14869                                 | 2167TCI<br>+1102 troop         | 81/21.7<br>Kap.2.4.1             | similar to damages RF13, RF14, RF20, RF35, RF37 | B              |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards

u = downwards

MR = several cracks

i.f. = in flight direction

g.f. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B2. DAMAGE TO RETRO FIT WINGS (continued)

| Damage no. | Section or component part no.      | Description of damage location | Wing station WS | Damage  |              |           | Determined after number of test hours | TCIP component and other hours | Explanation, see IABG report no. | Remarks and measures taken    | Classification |
|------------|------------------------------------|--------------------------------|-----------------|---------|--------------|-----------|---------------------------------------|--------------------------------|----------------------------------|-------------------------------|----------------|
|            |                                    |                                |                 | Type 1) | Direction 2) | Size (mm) |                                       |                                |                                  |                               |                |
| RF44       | Left wing 7210 front spar 783192-1 | 15 hinge units                 |                 |         |              |           | 14869                                 | 6182                           | 81/21.7 Kap.3.1.1                | similar to damages RF19, RF36 | 8              |
|            |                                    |                                | 39,0            | R       |              | 5,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 53,8            | R       |              | 6,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 54,0            | R       |              | 4,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 57,0            | R       |              | 2,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 59,5            | R       |              | 7,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 60,5            | R       |              | 8,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 61,8            | R       |              | 5,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 62,0            | R       |              | 8,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 64,2            | R       |              | 5,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 65,3            | R       |              | 7,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 66,5            | R       |              | 2,5       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 81,3            | R       |              | 1,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 87,0            | R       |              | 6,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 88,2            | R       |              | 8,0       |                                       |                                |                                  |                               |                |
|            |                                    |                                | 124,9           | R       |              | 2,5       |                                       |                                |                                  |                               |                |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE

| Damage no. | Section or component part no.      | Description of damage location  | Wing station WS | Damage  |              | Determined after number of test hours | Component hours (TCTP) | Explanation, see IABG report no. | Remarks and measures taken                        | Classification |
|------------|------------------------------------|---|-----------------|---------|--------------|---------------------------------------|------------------------|----------------------------------|---|----------------|
|            |                                    |   |                 | Type 1) | Direction 2) |                                       |                        |                                  |   |                |
| R1         | cover for rear fuel tank 776893-21 | right rounding hole at the end of the relief hole accordingly for the left side | 453,6           | R       |              | 911                                   | 536                    | 81/21.1                          | repair  | A              |
|            |                                    |   |                 | RV      |              | 1043                                  | 633                    |                                  |   |                |
|            |                                    |   |                 | RV      |              | 1089                                  | 679                    |                                  |   |                |
| R2         | skin fuselage                      | right front radius of the hydraulic flap opening accordingly for left side      | 520             | R       |              | 911                                   | 536                    |                                  | repair  | A              |
|            |                                    |   |                 | RV      |              | 1043                                  | 633                    |                                  |   |                |
|            |                                    |   |                 | RV      |              | 1089                                  | 679                    |                                  |   |                |
| R3         | skin fuselage                      | radius of the fuselage skin of the rear left longitudinal support               | 505             | R       |              | 1070                                  | 660                    | 81/21.2                          | similar to damages R6, R24, R44, R13, R36         | C              |
|            |                                    |   |                 | RV      |              | 1089                                  | 679                    | Kap. 2.1                         | repair by reinforcement                           |                |
|            |                                    |   |                 | R       |              | 1111                                  | 701                    | 81/21.3                          | no crack propagation up to 14869 hours            |                |
| R4         | skin fuselage                      | riveting at the upper side of the air inlet channel right                       | 444             | R       |              | 1153                                  | 743                    | 81/21.3                          | similar to damages R5, R8, R9, R10, R11, R19, R20 | 8              |
|            |                                    |   |                 | RV      |              | 3000                                  | 2590                   | Kap. 3                           | repair  |                |
|            |                                    |   |                 |         |              | total 69,6                            |                        |                                  |   |                |

1) R = crack

B = fracture

RV = crack extension

2)

o = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no. | Description of damage location | Wing station WS | Damage  |              | Determined after number of test hours | Component hours (TCTP) | Explanation, see IABC report no. | Remarks and measures taken                               | Classification |
|-------------------------------|--------------------------------|-----------------|---------|--------------|---------------------------------------|------------------------|----------------------------------|--|----------------|
|                               |                                |                 | Type 1) | Direction 2) | Size (mm)                             |                        |                                  |  |                |
| R5                            | skin fuselage                  | 448             | R       |              | 1,5 + 7                               | 2008                   | 1598                             | similar to damages R4, R8, R9, R10, R11, R19, R20, R47   | B              |
|                               | 761451-4                       |                 | RV      |              | 2,1 + 7,6                             | 2074                   | 1664                             |  |                |
| R6                            | skin fuselage                  | 520             | R       |              | 7,0                                   | 2050                   | 961                              | similar to damages R2, R24, R44, R13, R36                | A              |
|                               |                                |                 | RV      |              | 7,5                                   | 2138                   | 1049                             |  |                |
|                               |                                |                 | R       |              | 6,0                                   | 2050                   | 961                              |  |                |
|                               |                                |                 | RV      |              | 6,2                                   | 2138                   | 1049                             |  |                |
| R7                            | firewall                       | 505             | R       |              | 6 + 31                                | 2050                   | 1640                             | similar to damages R12 damage drilled away               | A              |
|                               | 761847-103                     |                 |         |              |                                       |                        |                                  |  |                |
|                               | 761847-104                     |                 |         |              |                                       |                        |                                  |  |                |
| R8                            | skin fuselage                  | 448             | R       |              | 3 + 8                                 | 2656                   | 2246                             | similar to damages R4, R5, R9, R10, R11, R19, R20 repair | B              |
|                               | 783194-2                       |                 | RV      |              | total 62                              | 3000                   | 2590                             |  |                |

1) R = crack

B = fracture

RV = crack extension

2) O = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Damage no. | Section or component part no.  | Description of damage location  | Wing station WS | Type 1) | Damage Direction 2) (mm) | Determined after number of test hours | Component hours (TCTP) | Explanation, see IABG report no. | Remarks and measures taken  | Classification |
|------------|--------------------------------|---|-----------------|---------|--------------------------|---------------------------------------|------------------------|----------------------------------|---|----------------|
| R9         | skin fuselage 761451-4         | riveting at the upper side of the air inlet channel, right. Crack passed from below | 456             | R       | A                        | 2656                                  | 2246                   | 81/21.3 Kap. 3                   | similar to damages R4, R5, R8, R10, R11, R19, R20                                   | B              |
|            |                                | radius of opening for the nose flap operation                                       |                 | RV      | 25,0                     | 3000                                  | 2590                   |                                  | repair  |                |
| R10        | frame part 761089-9            | cover attachment of opening for nose flap operation                                 |                 |         |                          |                                       |                        | 81/21.3 Kap. 3                   | similar to damages R4, R5, R8, R9, R11, R19, R20 exchange                           | B              |
|            |                                | upper crack   | 451             | R       | 32                       | 3000                                  | 2590                   |                                  |   |                |
|            |                                | lower crack   | 456             | R       | 30                       | 3000                                  | 2590                   |                                  |   |                |
| R11        | cover 761089-9                 | cover above opening for nose flap operation, right side                             | 451             | B       |                          | 3000                                  | 2590                   | 81/21.3 Kap. 3                   | similar to damages R4, R5, R8, R9, R10, R19, R20, R65 fracture of corner, exchanged | B              |
| R12        | firewall 761847-103 761847-104 | cracks in hole from damage R7   | 505             | R       | 6 + 50                   | 3000 14869                            | 2590 14459             | 81/21.3 Kap. 4                   | similar to damage R7 no crack extension   | A              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

I = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Damage no. | Section or component part no. | Description of damage location   | Wing station WS | Damage                         |  | Determined after number of test hours        | Component hours (TCIP)                       | Explanation, see IABC report no. | Remarks and measures taken                  | Classification |
|------------|-------------------------------|--|-----------------|--------------------------------|--|--|--|----------------------------------|---|----------------|
|            |                               |  |                 | Type 1)                        | Direction 2)                                     |  |  |                                  |   |                |
| R13        | skin fuselage                 | radius of first reinforcement plate for hydraulic flap opening accordingly for left side | 520             | RV                             | 10,8   | 4000   | 2911   | 81/21.2                          | similar to damages R2, R6, R24, R36, R44    | A              |
|            |                               |  |                 |                                |  |  |  |                                  |   |                |
|            |                               |  |                 |                                |  |  |  |                                  |   |                |
| R14        | angle profile 163787-86       | at bending radius right profile left profile   | 422             | R<br>RV<br>RV<br>R<br>RV<br>RV | 43,5<br>240,0<br>240,0<br>41,5<br>240,0<br>240,0 | 4486<br>5326<br>6407<br>4486<br>5326<br>6407 | 4076<br>4916<br>5997<br>4076<br>4916<br>5997 | 81/21.3 Kap. 5                   | similar to damages R16, R49<br><br>exchange | A              |
|            |                               |  |                 |                                |  |  |  |                                  |   |                |
|            |                               |  |                 |                                |  |  |  |                                  |   |                |
| R15        | skin fuselage                 | radius of ammunition area opening left side right side                                   | 335             | R<br>RV<br>R                   | 3,4<br>3,4<br>0,2                                | 5136<br>6407<br>5136                         | 4726<br>5997<br>4726                         | 81/21.3 Kap. 6                   | exchange<br><br>repair                      | C              |
|            |                               |  |                 |                                |  |  |  |                                  |   |                |
|            |                               |  |                 |                                |  |  |  |                                  |   |                |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no.                 | Description of damage location                          | Wing station MS | Damage        |                   | Determined after number of test hours | Component hours (TCTP) | Explanation, see IABC report no. | Remarks and measures taken                       | Classification |
|---|---|-----------------|---------------|-------------------|---------------------------------------|------------------------|----------------------------------|--|----------------|
|   |   |                 | Type 1)       | Direction 2) (mm) |                                       |                        |                                  |  |                |
| R16 angle profile                             | right passage hole                                      | 422             | R             | 25                | 5296                                  | 4886                   | 81/21.3 Kap. 5                   | similar to damages R14, R49 exchange             | A              |
| 769787-86                                     | left passage hole                                       |                 | RV<br>R<br>RV | 25<br>25<br>25    | 6407<br>5296<br>6407                  | 5997<br>4886<br>5997   |                                  | exchange   |                |
| R17 skin fuselage                             | plate field M48 near hinge for hydraulic flap           | 577.4           | R<br>RV       | 11,0<br>11,0      | 5562<br>14869                         | 5152<br>14459          | 81/21.3 Kap. 7                   |  | C              |
| R18 fuselage tail                             | lower connection fitting right left                     | 614             | R<br>R        | 2,0<br>2,0        | 5562<br>5562                          | 5152<br>5152           | 81/21.3 Kap. 17                  | similar to damage R33 exchange                   | C              |
| R19 fuselage skin                             | plate field M13 at upper side of left inlet air channel | 450             | R<br>RV       | 4,5<br>5,0        | 5799<br>6407                          | 5389<br>5997           | 81/21.3 Kap. 3                   | similar to damages R4, R5, R8, R9, R10, R11, R20 | B              |
| R20 skin fuselage                             | plate field M13, holes 15, 16, 17                       | 450             | R             | 4 ÷ 5             | 6344                                  | 5934                   | 81/21.3 Kap. 3                   | similar to damages R4, R5, R8, R9, R10, R11, R19 | B              |
| R21 bulge for landing flap actuator 761467-26 | both upper corner roundings right fuselage side         | 526,9<br>536,3  | R             | 40                | 6407                                  | 5997                   | 81/21.3 Kap. 8                   | similar to damages R25, R26, R27 exchange        | B              |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards  
u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

o = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure



TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no.                  | Description of damage location   | Wing station WS | Damage                          |              | Determined after number of test hours        | Component hours (TCIP)                       | Explanation, see IABC report no.             | Remarks and measures taken | Classification   |
|--|--|-----------------|---------------------------------|--------------|--|--|--|----------------------------|--|
|  |  |                 | Type 1)                         | Direction 2) | Size (mm)                                    |  |  |                            |  |
| R22 skin fuselage                              | sheet field M30, riveting with main spar 5, hole No. 2                                   | 520,5           | R<br>RV                         | G.F.<br>G.F. | 3,5<br>12,5                                  | 6407<br>14859                                | 5997<br>14459                                | 8/21.11 Kap. 2.1           | similar to damages R40 and R41   |
| R23 skin fuselage 75044-3                      | upper left radius of ground cooling door   | 558,0           | R<br>RV                         |              | 10,0<br>40,0                                 | 6407<br>11957                                | 5997<br>11547                                | 8/21.11 Kap. 2.2           | similar to damage R29 repaired   |
| R24 skin fuselage                              | radius of second reinforcement sheet of hydraulic flap opening accordingly for left side | 520             | R<br>R                          |              | 11,0<br>9,5                                  | 6407<br>6407                                 | 2407<br>2407                                 | 8/21.2                     | similar to damages R2, R6, R13, R44, R36<br>second repair plate replaced by third repair plate |
| R25 bulge for landing flap actuator, 761467-25 | right lower corner rounding left fuselage side   | 538,3           | R<br>RV<br>RV<br>RV<br>RV<br>RV |              | 22,3<br>22,5<br>23,0<br>32,0<br>33,0<br>33,0 | 6466<br>6540<br>6662<br>6845<br>7459<br>7805 | 6056<br>6130<br>6252<br>6435<br>7059<br>7395 | 8/21.3 Kap. 8              | similar to damages R21, R26, R27<br>exchange   |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
G.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Damage no. | Section or component part no.             | Description of damage location   | Wing station WS | Damage             |                            | Determined after number of test hours | Component hours (TCTP)       | Explanation, see IABG report no. | Remarks and measures taken                               | Classification |
|------------|---|--|-----------------|--------------------|----------------------------|---------------------------------------|------------------------------|----------------------------------|--|----------------|
|            |   |  |                 | Type 1)            | Direction 2)               |                                       |                              |                                  |  |                |
| R26        | bulge for landing flap actuator           | upper corner rounding<br>left<br>right                                     | 538,3<br>527,3  | R<br>RV<br>R<br>RV | 17<br>17<br>1 + 2<br>1 + 2 | 6845<br>7805<br>6845<br>7805          | 6435<br>7395<br>6435<br>7395 | 81/21.3<br>Kap. 8                | similar to damages R21, R26, R27<br>exchange<br>exchange | 8              |
| R27        | 761467-25 bulge for landing flap actuator | lower left corner rounding left fuselage side left fuselage side           | 527,3           | R<br>RV<br>RV      | 22,0<br>28,0<br>28,0       | 6845<br>7469<br>7805                  | 6435<br>7059<br>7395         | 81/21.3<br>Kap. 8                | similar to damages R21, R25, R26<br>exchange             | 8              |
| R28        | skin fuselage                             | sheet field M31 over the hydraulic flap left side                          | 530,7           | R<br>RV            | 66,6<br>66,6               | 6968<br>7108                          | 6558<br>6698                 | 81/21.3<br>Kap. 11               | similar to damages R30, R35, R52 repaired                | 8              |
| R29        | skin fuselage 775044-3                    | lower right radius of ground cooling door                                  | 546,5           | R<br>RV            | 3,2<br>33,0                | 6968<br>11957                         | 6558<br>11547                | 81/21.11<br>Kap. 2.2             | similar to damage R23 repaired                           | 8              |
| R30        | skin fuselage                             | sheet field M31 above the hydraulic flap, reinforcement sheet lower radius | 530,9           | R<br>RV            | 2,8<br>4,8                 | 7216<br>7534                          | 6806<br>7124                 | 81/21.3<br>Kap. 11               | similar to damages R28, R35, R52                         | 8              |
| R32        | skin fuselage                             | riveting of the sheet field M6 right side                                  | 405,8           | R<br>RV            | 2,9 + 6,5                  | 7216<br>12316                         | 6806<br>11906                | 81/21.11<br>Kap. 2.3             | similar to damage R37 repaired.                          | 8              |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards

u = downwards

MR = several cracks

I.F. = in flight direction

G.F. = against flight direction

i = inwards

a = outwards

I.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no.    | Description of damage location  | Wing station WS | Damage              |              |                          | Determined after number of test hours | Component hours (TCIP)         | Explanation, see JABC report no. | Remarks and measures taken               | Classification |
|----------------------------------|---|-----------------|---------------------|--------------|--------------------------|---------------------------------------|--------------------------------|----------------------------------|--|----------------|
|                                  |   |                 | Type 1)             | Direction 2) | Size (mm)                |                                       |                                |                                  |  |                |
| B33 fuselage tail                | lower connection fitting, left, crack in welding seam                   | 614             | R                   |              | 1,5                      | 7361                                  | 1799                           | 81/21.1 Kap. 17                  | similar to damage R18                    | C              |
| B34 air suction scoop 760218-101 | below the covering sheet 2 holes from bottom, left side                 | 423             | R                   |              | 5,7                      | 7351                                  | 1799                           | 81/21.3 Kap. 13                  | similar to damages R36, R39              | C              |
| R35 skin fuselage                | sheet field M31 above hydraulic flap, reinforcement plate, upper radius | 529,3           | R<br>RV<br>RV<br>RV |              | 1,6<br>3,5<br>4,0<br>4,0 | 7361<br>7374<br>10550<br>14869        | 6951<br>7124<br>10440<br>14459 | 81/21.11 Kap. 2.4                | similar to damages R28, R30, R52         | B              |
| R36 skin fuselage                | radius of third right reinforcement sheet of hydraulic flap opening     | 520             | R                   |              |                          | 7453                                  | 1062                           | 81/21.11 Kap. 2.6                | similar to damages R2, R6, R13, R24, R44 | A              |
| R37 skin fuselage                | riveting of sheet field M5, riveting hole 6                             | 405,8           | R<br>RV             |              | 3,3<br>5,5               | 7469<br>14869                         | 7059<br>14459                  | 81/21.11 Kap. 2.3                | similar to damage R32                    | B              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no. | Description of damage location             | Wing station WS | Damage  |              | Determined after number of test hours | Component hours (TCIP) | Explanation, see IABC report no. | Remarks and measures taken     | Classification |
|-------------------------------|--|-----------------|---------|--------------|---------------------------------------|------------------------|----------------------------------|--------------------------------|----------------|
|                               |  |                 | Type 1) | Direction 2) |                                       |                        |                                  |                                |                |
| R38                           | air inlet scoop                            | 422             | R       | g.F.         | 7469                                  | 7059                   | 81/21.11 Kap. 2.5                | similar to damages R34 and R39 | C              |
|                               |  |                 | R       | i.F.         | 9844                                  | 9434                   |                                  |                                |                |
|                               |  |                 | RV      | i.F.         | 11559                                 | 11149                  |                                  |                                |                |
|                               |  |                 | RV      | i.F.         | 13823                                 | 13413                  |                                  |                                |                |
|                               |  |                 | R       | g.F.         | 13449                                 | 13039                  |                                  |                                |                |
|                               |  |                 | RV      | g.F.         | 13823                                 | 13413                  |                                  |                                |                |
|                               |  |                 | RV      | g.F.         | 14178                                 | 13768                  |                                  |                                |                |
|                               |  |                 | RV      | g.F.         | 14869                                 | 14455                  |                                  |                                |                |
| R39                           | air inlet scoop                            | 422             | R       |              | 7469                                  | 7059                   | 81/21.3 Kap. 13                  | similar to damages R34 and R38 | C              |
|                               |  |                 | RV      |              | 14869                                 | 14459                  |                                  |                                |                |
| R40                           | skin fuselage                              |                 |         |              |                                       |                        |                                  | similar to damages R22 and R41 | B              |
|                               | sheet field M30, riveting with main rib 5  | 520,5           | R       | i.F.         | 7506                                  | 7056                   | 81/21.11 Kap. 2.1                |                                |                |
|                               | second hole                                |                 | RV      | i.F.         | 14869                                 | 14459                  |                                  |                                |                |
|                               | first hole                                 |                 | R       | g.F.         | 13685                                 | 13275                  |                                  |                                |                |
|                               |  |                 | RV      | g.F.         | 14869                                 | 14459                  |                                  |                                |                |
| R41                           | skin fuselage                              |                 |         |              |                                       |                        |                                  | similar to damages R22 and R40 | B              |
|                               | sheet field M30, riveting with main spar 5 | 520,5           | R       | g.F.         | 7534                                  | 7124                   | 81/21.11 Kap. 2.1                |                                |                |
|                               | third hole                                 |                 | RV      | g.F.         | 14869                                 | 14459                  |                                  |                                |                |
|                               |  |                 | R       | i.F.         | 14869                                 | 14459                  |                                  |                                |                |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no. | Description of damage location                                      | Wing station WS         | Damage                                   |  | Determined after number of test hours  | Component hours (TCIP)   | Explanation, see IABG report no. | Remarks and measures taken  | Classification |
|-------------------------------|---|-------------------------|--|--|--|--|----------------------------------|---|----------------|
|                               |   |                         | Type 1)                                  | Direction 2) (mm)  |  |  |                                  |   |                |
| R42 skin fuselage             | doubler below sheet field M53 first crack second crack third crack  | 433,3<br>439,5<br>503,5 | R<br>R<br>R                              | 24,0<br>16,0<br>41,0   | 7805<br>7805<br>7805   | 7395<br>7395<br>7395   | 81/21.3<br>Kap. 14               | Similar to damages R45, R59, R60, R73, R74, R75, R76 exchange   | B              |
| R43 rear fuel container space | upper longitudinal support  | 438,3                   | R  | 17   | 8304   | 7894   | 81/21.3<br>Kap. 15               |   | B              |
| R44 skin fuselage             | radius of third right reinforcement sheet of hydraulic flap opening | 520                     | R  |  | 8780   | 8370   | 81/21.11<br>Kap. 2.6             | similar to damages R2, R6, R13, R24, R36  | C              |
| R45 skin fuselage             | doubler below sheet field M53 Rivet 1 Rivet 2 Rivet 3 Rivet 4       | 501                     | R<br>RV<br>R<br>RV<br>R<br>RV<br>R<br>RV | 3,0<br>6,5<br>7,0<br>3)<br>7,5<br>3,0<br>3)<br>2,0<br>9,8<br>3,0<br>10,0 | 8978<br>10504<br>8854<br>10504<br>10504<br>8854<br>10504<br>9587<br>10504<br>8978<br>10504 | 8568<br>10094<br>8444<br>10094<br>10094<br>8444<br>10094<br>9177<br>10094<br>8568<br>10094 | 81/21.11<br>Kap. 3.1             | similar to damages R42, R59, R60, R73, R74, R75, R76<br><br>damage repaired at 10504 total test hours | B              |

1) R = crack

B = fracture

RV = crack extension

2) 0 = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no.         | Description of damage location                                     | Wing station WS | Damage  |              | Determined after number of test hours | Component hours (TCTP) | Explanation, see IARG report no. | Remarks and measures taken                | Classification |
|---------------------------------------|--|-----------------|---------|--------------|---------------------------------------|------------------------|----------------------------------|---|----------------|
|                                       |  |                 | Type 1) | Direction 2) |                                       |                        |                                  |   |                |
| R46 frame part 761089-3               | cover attachment of opening for nose flap attachment               | 452             | R       | g.F.         | 8987                                  | 5987                   | 81/21.11 Kap. 3.2                | similar to damages R10, R65               | C              |
| R47 skin fuselage                     | riveting of sheet field M13 hole No. 9 to 16, left                 | 444             | R       | l.F.         | 10093                                 | 7093                   |                                  |   |                |
|                                       |  |                 | RV      | l.F.         | 11957                                 | 8057                   |                                  |   |                |
| R48 skin fuselage                     | riveting of sheet field M12 with upper longitudinal support, right | 456             | R       | 3,5 *        | 9353                                  | 8943                   | 81/21.11 Kap. 3.3                | similar to damages R5, R54                | B              |
|                                       |  |                 | RV      | 5,0          | 14178                                 | 13768                  |                                  |   |                |
|                                       |  |                 |         | 3,8 *        |                                       |                        |                                  |   |                |
|                                       |  |                 |         | 11,0         |                                       |                        |                                  |   |                |
| R49 angle profile 769787-86 769787-85 | at bending radius left profile right profile                       | 422             | R       | 3,0          | 9479                                  | 9069                   | 81/21.11 Kap. 3.4                | similar to damage R56                     | C              |
|                                       |  |                 | RV      | 3,0          | 14869                                 | 14459                  |                                  |   |                |
|                                       |  |                 | R       | 3,0          | 13449                                 | 13039                  |                                  |   |                |
|                                       |  |                 | RV      | 3,0          | 14869                                 | 14459                  |                                  |   |                |
| R50 skin fuselage                     | riveting of sheet field M6 right side hole 5                       | 399,6           | R       | 20,0         | 9705                                  | 3298                   | 81/21.11 Kap. 3.5                | similar to damages R14, F16               | A              |
|                                       |  |                 | RV      | 20,0         | 14469                                 | 8562                   |                                  |   |                |
|                                       |  |                 | R       | 15,0         | 9705                                  | 3298                   |                                  |   |                |
|                                       |  |                 | RV      | 60           | 14469                                 | 8062                   |                                  |   |                |
| R51 skin fuselage                     | sheet field M36, rivet hole for attaching hydraulic flap hinge     | 577,5           | R       | 3,5          | 9705                                  | 9295                   | 81/21.11 Kap. 3.7                | similar to damages R32, R37, R53 repaired | B              |
|                                       |  |                 | RV      | 7,5          | 12316                                 | 11906                  |                                  |   |                |
|                                       |  |                 | R       | 3,7          | 11957                                 | 11547                  |                                  |   |                |
|                                       |  |                 | RV      | 4,0          | 12316                                 | 11906                  |                                  |   |                |
|                                       |  |                 | R       | 4,0          | 9705                                  | 9295                   | 81/21.11 Kap. 3.8                |   | C              |
|                                       |  |                 | RV      | 4,0          | 14869                                 | 14459                  |                                  |   |                |

1) R = crack

B = fracture

RV = crack extension

u = upwards

u = downwards

MR = several cracks

l.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no.  | Description of damage location  | Wing station WS | Damage                                   |                                      | Determined after number of test hours                                | Component hours (TCIP)   | Explanation, see IABG report no. | Remarks and measures taken                               | Classified - |
|--------------------------------|---|-----------------|--|--------------------------------------|--|--|----------------------------------|--|--------------|
|                                |   |                 | Type 1)                                  | Direction 2)                         |  |  |                                  |  |              |
| R52 skin fuselage              | sheet field M30, right side   | 530,7           | R<br>RV                                  |                                      | 10850<br>11937   | 10440<br>11527   | 81/21.11<br>Kap. 3.9             | similar to damage R28, R30, R35<br>Repaired              | B            |
| R53 skin fuselage              | riveting of sheet field M6<br>Hole 4                                    | 399,6           | R<br>RV<br>R<br>RV                       | u<br>u<br>c<br>o                     | 10850<br>12316<br>11559<br>12316                                     | 10410<br>11936<br>11149<br>11906                                     | 81/21.11<br>Kap. 3.7             | similar to damages R32, R37, R50<br>Repaired<br>Repaired | B            |
| R54 skin fuselage              | riveting of sheet field M13<br>Hole 11<br>Hole 12<br>Hole 13<br>Hole 14 | 440,6           | R<br>RV<br>R<br>RV<br>R<br>RV<br>R<br>RV | u<br>u<br>u<br>u<br>u<br>u<br>u<br>u | 11957<br>14869<br>14093<br>14869<br>14093<br>14869<br>11957<br>14869 | 11547<br>14459<br>13683<br>14459<br>13683<br>14869<br>11547<br>14459 | 81/21.11<br>Kap. 3.3             | similar to damages R4 and R47                            | B            |
| R55 upper longitudinal support | lower flange for ground longitudinal support                            | 422             | R  |                                      | 12516  | 11906  | 81/21.11<br>Kap. 3.6             | repaired   | A            |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no. | Description of damage location   | Wing station WS | Damage                                   |                                      | Determined after number of test hours               | Component hours (TCTP)   | Explanation, see IABC report no.                                     | Remarks and measures taken   | Classification |
|-------------------------------|--|-----------------|--|--------------------------------------|---|--|--|--|----------------|
|                               |  |                 | Type 1)                                  | Direction 2)                         | Size (mm)   |  |  |  |                |
| R56 skin fuselage             | riveting of sheet field M12 with upper longitudinal support                      | 458             | R<br>RV                                  |                                      | 2,5<br>2,5  | 12702<br>14869   | 12292<br>14459   | 81/21.11 Kap. 3.6<br>similar to damage R48                                 | C              |
| R57 frame part                | attachment of cover at opening to oil tank<br>first crack<br>second crack        | 536,5           | R<br>RV<br>R<br>RV<br>R<br>RV<br>R<br>RV | o<br>o<br>o<br>o<br>o<br>o<br>o<br>o | 4,5<br>4,5<br>4,5<br>4,5<br>3,5<br>7,0<br>5,5<br>3) | 13325<br>14869<br>13325<br>14869<br>13325<br>14869<br>13325<br>14869 | 12915<br>14459<br>12915<br>14459<br>12915<br>14459<br>12915<br>14459 | 81/21.11 Kap. 3.8<br>similar to damages R68, R69, R71                      | C              |
| R58 main longitudinal support | outer reinforcement at opening for air removal line                              | 479,5           | R<br>RV                                  |                                      | 5,0<br>22,0 3)                                      | 13056<br>13449   | 12646<br>13039   | 81/21.11 Kap. 3.10<br>similar to damages R42, R45, R60, R73, R74, R75, R76 | B              |
| R59 skin fuselage             | riveting of sheet field M53 at inspection opening for pressurized air controller | 536,5           |  |                                      |   |  |  | 81/21.11 Kap. 3.1  | B              |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure



TABLE R3. DAMAGE TO FUSELAGE (continued)

| Section or component part no. | Description of damage location  | Wing station WS | Damage  |                   | Determined after number of test hours | Component hours (TCIP) | Explanation, see IABG report no. | Remarks and measures taken                           | Classification |
|-------------------------------|---|-----------------|---------|-------------------|---------------------------------------|------------------------|----------------------------------|--|----------------|
|                               |   |                 | Type 1) | Direction 2) (mm) |                                       |                        |                                  |  |                |
| R59                           | hole 1  |                 | R       | 0                 | 1325                                  | 12915                  |                                  |  |                |
|                               |   |                 | RV      | 0                 | 13823                                 | 13413                  |                                  |  |                |
|                               |   |                 | R       | 0                 | 13725                                 | 12915                  |                                  |  |                |
|                               |   |                 | RV      | 0                 | 13823                                 | 13413                  |                                  |  |                |
|                               | hole 2  |                 | R       | 0                 | 13325                                 | 12915                  |                                  |  |                |
|                               |   |                 | RV      | 0                 | 14093                                 | 13683                  |                                  |  |                |
|                               |   |                 | R       | 0                 | 13325                                 | 12915                  |                                  |  |                |
|                               |   |                 | RV      | 0                 | 13823                                 | 13413                  |                                  |  |                |
| R60                           | skin fuselage riveting of sheet field N53 next to radius for fuel valve opening | 503,4           | R       | 0                 | 13449                                 | 13039                  | 81/21.11 Kap. 3.1                | similar to damages R42, R45, R59, R73, R74, R75, R76 | B              |
|                               |   |                 | RV      | 0                 | 14178                                 | 13768                  |                                  |  |                |
| R61                           | skin fuselage rear radius of ammunition space opening, right side               | 335             | R       | 0                 | 13449                                 | 13039                  | 81/21.11 Kap. 3.11               |  | C              |
|                               |   |                 | RV      | 0                 | 14869                                 | 14459                  |                                  |  |                |
| R62                           | longitudinal support landing gear track right side left side                    | 444,4           | R       | 58,0              | 13039                                 |                        | 81/21.11 Kap. 3.12               |  | B              |
|                               |   |                 | RV      | 58,0              | 14459                                 |                        |                                  |  |                |
|                               |   |                 | R       | 48,0              | 13039                                 |                        |                                  |  |                |
|                               |   |                 | RV      | 58,0              | 14459                                 |                        |                                  |  |                |

1) R = crack

B = fracture

RV = crack extension

2) 0 = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no.    | Description of damage location                        | Wing station WS | Damage  |              |           | Determined after number of test hours | Component hours (TCTP) | Explanation, see IABC report no. | Remarks and measures taken | Classification |
|----------------------------------|---|-----------------|---------|--------------|-----------|---------------------------------------|------------------------|----------------------------------|----------------------------|----------------|
|                                  |   |                 | Type 1) | Direction 2) | Size (mm) |                                       |                        |                                  |                            |                |
| R63<br>profile sheet<br>760491 L | left side<br>hole 2                                   | 444,4           | R       | o            | 5,4       | 13595                                 | 13175                  | 81/21.11<br>Kap. 3.12            | similar to<br>damage R64   | B              |
|                                  |   |                 | RV      | o            | 6,7       | 14869                                 | 14459                  |                                  |                            |                |
|                                  |   |                 | R       | u            | 7,8       | 13585                                 | 13175                  |                                  |                            |                |
|                                  |   |                 | RV      | u            | 8,5       | 14869                                 | 14459                  |                                  |                            |                |
|                                  |   |                 | R       | o            | 4,8       | 13585                                 | 13175                  |                                  |                            |                |
| R64<br>profile sheet<br>760491 R | right side<br>hole 2                                  | 444,4           | RV      | o            | 5,0       | 14869                                 | 14459                  | 81/21.11<br>Kap. 3.12            | similar to<br>damage R63   | B              |
|                                  |   |                 | R       | o            | 10,0      | 13585                                 | 13175                  |                                  |                            |                |
|                                  |   |                 | RV      | o            | 13,0      | 14869                                 | 14459                  |                                  |                            |                |
|                                  |   |                 | R       | u            | 14,4      | 13585                                 | 13175                  |                                  |                            |                |
|                                  |   |                 | RV      | u            | 3)        | 14869                                 | 14459                  |                                  |                            |                |
| R65<br>cover<br>761389-9         | cover above opening of nose flap operation right side | 452             | R       | o            | 8,6       | 13585                                 | 13175                  | 81/21.11<br>Kap. 3.2             | similar to<br>damage R11   | C              |
|                                  |   |                 | R       | o            | 3)        | 14869                                 | 14459                  |                                  |                            |                |
|                                  |   |                 | RV      | u            | 5,9       | 13585                                 | 13175                  |                                  |                            |                |
|                                  |   |                 | R       | u            | 7,4       | 14869                                 | 14869                  |                                  |                            |                |
|                                  |   |                 | RV      | u            | 3)        | 13823                                 | 10823                  |                                  |                            |                |
| R66<br>upper covering plate      | hole 15   | 416,3           | R       | i.F.         | 3,0       | 13823                                 | 10823                  | 81/21.11<br>Kap. 3.13            |                            | C              |
|                                  |   |                 | R       | g.F.         | 3,2       | 14869                                 | 11869                  |                                  |                            |                |
|                                  |   |                 | RV      | g.F.         |           |                                       |                        |                                  |                            |                |
|                                  |   |                 | R       | o            | 4,0       | 14093                                 | 13683                  |                                  |                            |                |
|                                  |   |                 | RV      | o            | 4,0       | 14869                                 | 14459                  |                                  |                            |                |
|                                  |   |                 | R       | u            | 5,3       | 14093                                 | 13683                  |                                  |                            |                |
|                                  |   |                 | RV      | u            | 5,3       | 14869                                 | 14459                  |                                  |                            |                |
|                                  |   |                 | R       | u            |           |                                       |                        |                                  |                            |                |
|                                  |   |                 | RV      | u            |           |                                       |                        |                                  |                            |                |
|                                  |   |                 |         |              |           |                                       |                        |                                  |                            |                |

1) R = crack  
B = fracture  
RV = crack extension

2) o = upwards  
u = downwards  
MR = several cracks  
i.F. = in flight direction  
g.F. = against flight direction

i = inwards  
a = outwards  
i.S. = in span direction  
R.M. = to fuselage center

Kap = chapter  
ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no.  | Description of damage location  | Wing station WS | Damage Type 1) Direction 2) (mm) | Determined after number of test hours | Component hours (TCTP) | Explanation, see IABC report no. | Remarks and measures taken                 | Classification |
|--------------------------------|---|-----------------|----------------------------------|---------------------------------------|------------------------|----------------------------------|--|----------------|
| R67 skin                       | right side hole 1   | 520,5           | R i.f. 2,2<br>R g.f. 1,8         | 14869<br>14869                        | 14459<br>14459         | 81/21.11<br>Kap. 3.14            |  | A              |
| R68 basic longitudinal support | outer reinforcement on the ventilation line hole, right side              | 479,5           | R u 14,0                         | 14869                                 | 14459                  | 81/21.11<br>Kap. 3.10            | similar to damages R58, R69, R70, R71, R72 | B              |
| R69 basic longitudinal support | outer riveted reinforcement, right side                                   | 489,5           | R u 2,0                          | 14869                                 | 14459                  | 81/21.11<br>Kap. 3.15            | similar to damages R58, R68, R70, R71, R72 | B              |
| R70 basic longitudinal support | outer riveted reinforcement, right side                                   | 505,0           | R u 2,3                          | 14869                                 | 14459                  | 81/21.11<br>Kap. 3.10            | similar to damages R58, R68, R69, R71, R72 | B              |
| R71 basic longitudinal support | external riveted reinforcement at opening for air removal line, left side | 479,5           | R o 13,5                         | 14869                                 | 14459                  | 81/21.11<br>Kap. 3.10            | similar to damages R58, R68, R69, R72      | B              |
| R72 basic longitudinal support | external riveted reinforcement  | 489,5           | R u 2,5<br>R 1,5                 | 14869<br>14869                        | 14459<br>14459         | 81/21.11<br>Kap. 3.10            | similar to damages R58, R68, R69, R70, R71 | B              |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards

u = downwards

MR = several cracks

i.f. = in flight direction

g.f. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.N. = to fuselage center

Kap = chapter

ABB = figure

TABLE B3. DAMAGE TO FUSELAGE (continued)

| Section or component part no. | Description of damage location  | Wing station WS  | Damage  |              | Determined after number of test hours | Component hours (TCTP) | Explanation, see IABG report no. | Remarks and measures taken  | Classification |
|-------------------------------|---|------------------|---------|--------------|---------------------------------------|------------------------|----------------------------------|---|----------------|
|                               |   |                  | Type 1) | Direction 2) | Size (mm)                             |                        |                                  |   |                |
| R73 skin fuselage             | Riveting of sheet field M53 with M33, left side                             | 513,9 +<br>514,2 | R       |              | 20,0                                  | 14869                  | 14459                            | 81/21.11 Kap. 3.1<br>similar to damages R42, R45, R68, R60, R74, R75, R76 | B              |
| R74 skin fuselage             | sheet field M53, cavity for pressurized air controller cover, left side     | 513,0 +<br>513,5 | R       | g.F.         | 25                                    | 14869                  | 14459                            | 81/21.11 Kap. 3.1<br>similar to damages R42, R45, R59, R60, R73, R75, R76 | B              |
| R75 skin fuselage             | sheet field M53, cavity for compressed air controller cover, left side, top | 512,7            | R       |              | 11,0                                  | 14869                  | 14459                            | 81/21.11 Kap. 3.1<br>similar to damages R42, R45, R59, R60, R73, R74, R75 | B              |
| R76 skin fuselage             | sheet field M53, cavity for compressed air controller cover, left side      | 511,4            | R       |              | 25,0                                  | 14869                  | 14459                            | 81/21.11 Kap. 3.1<br>similar to damages R42, R45, R59, R60, R73, R74, R75 | B              |
| R77 main rib No. 5            | right side hole 6   | 520,5            | R       | i.F.         | 1,6                                   | 14869                  | 14459                            | 81/21.11 Kap. 3.14  | A              |
|                               | left side hole 7  |                  | R       | g.F.         | 1,0                                   | 14869                  | 14459                            |   |                |

1) R = crack

B = fracture

RV = crack extension

2) o = upwards

u = downwards

MR = several cracks

i.F. = in flight direction

g.F. = against flight direction

i = inwards

a = outwards

i.S. = in span direction

R.M. = to fuselage center

Kap = chapter

ABB = figure

DOCUMENTATION DATA FOR THE REPORT TF 81/20

TITLE: TOTAL AIRFRAME FATIGUE TEST F 104 G FINAL REPORT

REFERENCE WORDS

OR KEY WORDS: (Characteristic words/concepts from the title, text, and topic to be used for document selection)

(If possible, less than 8 -- 10 lines, about 100 words)

ABSTRACT:

a) Type of  
Content

and

b) Summary  
of the  
Technical  
Results

This final report contains the most important information and data concerning the test configuration, test sequence, and results of the F 104 G total airframe fatigue experiment. Details are documented in 31 additional partial reports. In addition, the tables of Appendix B summarize all the damage which the structure experienced during the fatigue experiment. Because of cross references in the text and in the tables, this report can be used for the information contained in the partial reports. This final report includes an evaluation of the most important results (damage) and contains recommendations for measures to be taken or references to actions already taken.

REFERENCE: (fill in when the reference is important for documentation)

AUTHOR: R. Schütz